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Central-Station Service Interruption

A boiler recently exploded in the Staten Island generating station of the Richmond Light & Railroad Company. As noted in our issue dated Oct. 25, no damage was done to the engine equipment and most of the boilers were unharmed, the exploding vertical boiler taking a skyward course and dropping into the river adjoining the station. In its upward flight the boiler tore out a portion of the breeching and a section of the roof, thereby cutting off the other boilers from the stack and strewing wreckage about the room. Our purpose is not here to dwell on the reasons for the explosion, for boilers have a habit of doing this kind of thing when forced to it. We desire to direct attention to the fact that five days were consumed in restoring service in a great and resourceful community like New York. A wide-awake company would have chartered a steamer, made an emergency connection between her boilers and the station header and restored service before the next night, if no quicker means were at hand. Of what avail were the glorious examples at Dayton, Hot Springs and a host of other cities to the company on Staten Island? Can it be possible that the sacrifices and heroic efforts there made to restore service have been in vain? Had the entire station been destroyed, the fault would not have been so great; but under the circumstances the record is not an enviable one. It outrages the grandest tradition of the central-station industry, that of service at all hazards and at any cost. It implies that the interests of the company are distinct from those of the community which it serves and assumes that a lighting monopoly was created to be abused. Happily the central-station industry as a whole has a livelier sense of its obligations to its patrons than that shown on this occasion. Its progress is not presaged on such errors of omission; otherwise it would dry up the sources of its prosperity.

The Brush Discharge

It is curious that in the early history of electricity the electric brush discharge was well known and much discussed. Needles and sharp-pointed conductors, connected to a frictional electrostatic machine, gave off this discharge, and the experimental display of this in a dark room was very popular in the eighteenth century. At the present time the brush discharge is looked upon as a nuisance in high-tension energy transmission and, as such, to be prevented as far as possible. There is, however, one useful accompaniment of the brush discharge, and that is ozone production in air. This is described at some length by Mr. A. Vosmaer in *Metallurgical and Chemical Engineering*, as abstracted in our Digest. It seems that the brush discharge is intermediate to the electric glow on one side and the electric spark on the other. The particular type of air bombardment which accompanies it seems to result in the formation of ozone. The peculiar difficulties to which ozone generators are subject make a narrative of considerable interest.

Surplus of Public Utilities

The surplus of a public utility which Mr. Barker, of the Massachusetts commission, had in mind when he wrote the paper published in abstract in this issue is evidently that of a fully regulated company. Since practically all companies are either in this position now or are in a fair way to be subject to close state supervision soon, his discussion has a direct bearing on the general questions involved. It should be borne in mind, however, that owing to the long existence of the Massachusetts policy of regulation a surplus in that State may be regarded as legally open to treatment different from one built up by a company not subject to regulation during the greater part of the period of accumulation. As we understand the substance of the argument, it is that the bargain between the State and the company contemplates that there shall be reasonable rates for service, protection of both the monopoly and the investment and a reasonable rate of return. To this there may be added a definite provision that for unusual economy or efficiency an addition to the rate of return shall be allowed, and we think that such an incentive to development would be an advantage that the State could well afford to give. If a schedule of rates is proportioned properly upon a fair and recognized investment, a surplus accumulates because the natural growth of business tends under normal conditions to reduce the unit costs of operation. In other words, increased volume of business assures increased margin of profits. Under Mr. Barker's plan the increase would be applied, not as a matter of right to extra dividends or directly to the public interested in the service, but to those uses which are the common concern of both parties to the bargain. One of the features of such a plan has been followed for many years by one of the largest railroad companies in the country. "One dollar for dividends, one dollar for improvements," has been its policy. An encouraging element in a plan of this nature, broadened to meet the conditions of other forms of public utility service, is that it will probably help to make good those elements of depreciation which are inevitable in these properties. Mr. Barker recognizes that the losses on unremunerative new extensions must be met from some source until such time as the new additions to the property reach a self-supporting basis. It should be recognized just as clearly that depreciation is an element for consideration in rate-mak-

ing. If the surplus for the future may be used in part to overcome some of the uncontrollable losses in capital value arising from depreciation in the past, the result will be advantageous. This policy is wholly reasonable in cases where, notwithstanding proper management, earnings have not been sufficient to overcome these losses and to yield a fair return on the investment; and it is not an unreasonable policy for the State to elect to follow with many public service corporations where the conditions have been closely similar. We note, however, that Mr. Barker does not feel that it would be prejudicial to the public interest to use at least part of a surplus developed under the general conditions of regulation outlined to increase the otherwise reasonable rate of return upon actual investment of stockholders. This may be done in the form of an allowance for unusual efficiency if management of such a character is developed. It is necessary to be done, however, in cases where a percentage greater than the going market rate for money is demanded by investors who would not otherwise take the risks apparent in the enterprise seeking capital at the time.

High-Frequency Alternators for Radio-Telegraphy

An article recently published in *La Lumière Electrique*, by M. Bouthillon, as abstracted in our Digest, draws attention to a theory of high-frequency alternators capable of being applied to radio-telegraphy. All of the early radiation experiments of Hertz were made with free oscillations of a few meters wave-length, accompanied by frequencies up to hundreds of millions per second. Later on, radio-telegraphic signals came to be made with free oscillations of a few hundred meters wave-length, accompanied by frequencies of the order of millions per second. Fessenden was the first in this country to point out that great advantages would be secured by substituting forced oscillations for free oscillations. That is, free oscillations are feeble, not only because they have to be separated by relatively long inactive intervals but also because they are necessarily heavily damped by active radiation. If an alternating-current generator could be hitched to the sending-station mast wire, so as to be in resonance with it, the mast could be kept in continuous electric oscillation of great radiative power. The change is like replacing the piano by the pipe organ.

It is well known that when a properly constructed ring-wound or delta-wound three-phase generator is driven at a fundamental frequency of, say, 60 cycles per second, the closed circuit of the armature contains no resultant emf of that frequency, which emf is taken off at 120 deg. taps. Moreover, there will be no resultant harmonic emf of 5, 7, 11, 13, etc., times the fundamental in the closed armature circuit. All such harmonics cancel out all the way round the armature, and their instantaneous sum is individually zero. Such is not true, however, of the triple or $3n$-ple harmonics. It is well known that the harmonic emfs of frequencies of 180, 540, etc., cycles per second do not cancel out, but add up and send short-circuit currents of those frequencies through the winding of 60-cycle machines, so that such triple-frequency harmonics are designedly kept small. Similarly, a five-phase alternator of the ring-wound type and generating, say, a fundamental frequency of 100 cycles per second would send no short-circuit current of that frequency through the closed armature-ring winding; but the fifth harmonic of 500 cycles per second would leave a resultant emf. If the armature ring were opened at some point and taken to an external circuit, an emf of 500 cycles per second might be looked for in that circuit, but no emf of 100 cycles per second, if the machine was accurately constructed.

Proceeding in this way, if a ring-armature machine of relatively high fundamental frequency be so built as to exaggerate some high harmonic of that frequency, one can cut the ring and find in the external circuit no fundamental frequency, but an augmented magnitude of the harmonic. Consequently, instead of trying to suppress all harmonics and to keep a pure sinusoidal fundamental frequency, as is the modern practice for energy-transmission generators, for radio-transmission generators one should seek to develop a high fundamental frequency, say 2000 cycles per second, and then exaggerate as much as possible a particular glorified high harmonic, say the forty-ninth. Then, with forty-nine pairs of poles, when the ring armature is opened at some convenient point, one should find at its terminals no resultant emf of 2000 cycles per second, but a relatively large resultant emf of 98,000 cycles per second. By means of a suitably resonant circuit, this high frequency could be still further augmented and purified. This principle of stimulating an inordinately vicious high harmonic illustrates the proverb that "one man's meat may be another man's poison."

Electric Ship Propulsion

At first thought to drive a ship by means of electrical energy transmitted from generators to motors only a few score feet away would seem to be a misapplication of ingenuity, but such is not the case. Just at the present time two good-sized vessels are under test, both equipped with electric drive of different kinds and for different purposes. One of them is the United States collier *Jupiter*, of which we have already given some account; the other is the cargo boat *Tynemount*, built in England for use on the Great Lakes, as described in this issue. Although absolutely different in equipment, both vessels disclose the great fundamental advantage of electric drive for ships, the complete independence of engine speed and propeller speed. The ordinary reciprocating engine is well fitted for ship propulsion so far as its normal running speed is concerned. Its rotations fit very well those of a propeller able to absorb the power of the engine while retaining an efficient speed. In the *Jupiter* use is made of the electric drive for the purpose of getting an efficient propeller speed, while the power is delivered from a turbo-generator running at its most efficient speed. The trouble with turbine propulsion in ships generally, although it is largely used, is that at the speed of maximum efficiency for the turbine propeller is worked at an inefficient speed, the most efficient speed for the propeller being quite different. Between the two the losses are quite sufficient to justify the use of electric drive.

The *Tynemount* has been equipped in an attempt to get best running conditions for marine propulsion out of a Diesel engine. Steady and fairly high speed in the prime mover is required, while for the most efficient use of the propeller in a cargo boat both low relative speed and a sufficient range of speed are necessary. A cargo boat is not ordinarily a fast craft, and engines running at several hundred revolutions a minute are not best suited for the requirements. In the *Tynemount* the motive power is obtained from two six-cylinder high-speed Diesel engines, each coupled to a three-phase generator. The duplicate equipment gives, in the first place, a relay in case of breakdown and, in the second place, an extremely simple and ingenious method of obtaining reduced speed without loss of efficiency. The two generators, which run at the same speed, have six and eight poles respectively. The propeller is driven by an induction motor having two separate stator windings, one of thirty and the other of forty poles. At normal engine speed these relations give the same synchronous speed of 80 r.p.m. at the motor. The full-load torque of both engines is available. When reduced speed is desired the six-pole generator is connected to the forty-pole winding of the motor, and the synchronous motor speed then drops to 60 r.p.m., at which the propeller gives proper load conditions for the single engine in operation. It will be seen that the conditions in the *Tynemount* are radically different from those found in the *Jupiter*. However, the arrangements in each case meet the requirement of high efficiency in the drive considered as a whole. We shall be very greatly interested in further reports of the actual results of tests on both these extremely ingenious and promising vessels. The possibilities of the turbine ship with electric drive, particularly for naval use, loom very large, yet the oil engine deserves a good trial, and the introduction of the electric motor certainly serves to free it from some of its disabilities.

Indian Hydroelectric System

Of building hydraulic transmission plants there is no end, and most of them, to tell the truth, present few features of striking interest, so thoroughly have the apparatus and methods been standardized within the last few years. The great Indian plant which we describe this week, however, is an exception to this dismal rule. It is not only unusually large and worked at the highest range of voltage but it presents some very unusual features. The objective point is Bombay, and the situation of the hydraulic works is on the slopes of the great coast range known as the Western Ghats. This range rises to a height of some 3000 ft., and rain falling on its western declivity runs directly seaward. The southwest monsoon brings an enormous rainfall, and it is on the basis of the storage of this water that the hydraulic scheme has been carried out. The rainfall from thirty years' records on the watershed involved rises to the prodigious figure of nearly 200 in. The first distinguished feature, then, of this plant is the storage during the rainy season of water on so huge a scale as to carry the plant over all the periods of low water. At the height of the rains there is ample power with very little reliance on the storage, but for the most part the artificial lakes are the source of the power. Use is made of three lakes lying nearly fifty miles a little southeast of Bombay. The first and nearest to the power house is peculiarly a storage basin for the inequalities of the rainy season. The storage at this point is a little short of 500,000,000 cu. ft. Back of this minor reservoir lie two others. The first, about 35 ft. higher in level than the smaller reservoir, will impound more than 2,500,000,000 cu. ft. The third and greatest storage lake lies in a valley with an area of five square miles, and the storage when the lake is full will rise to the tremendous total of 7,000,000,000 cu. ft. This is by far the most elaborate and comprehensive storage scheme with artificial lakes which we remember as forming a part of a power development.

One of the interesting features of the installation is the provision made for regulating the speed of the wheels and protecting the pipe lines against sudden changes of load. The governors are of the oil-pressure type worked by servo-motors so closely set as to limit the variation to 2.5 per cent when quarter load is thrown off. The feature of the governors which is of particular interest is the provision made for taking care of both slow and rapid variations of load. Slow variations are very simply handled by a needle valve, thus economizing water to the utmost. On the occasion of a sudden variation due to loss of load the servomotor of the governor operates the deflecting nozzle without at once shifting its needle valve, and then when the nozzle swings back regulation goes on as before. All danger of excess pressure on the pipe line is thus removed. In case of increase of load the whole governing is quickly done with the needle valve.

It should be a matter of much pride to American engineers that although the hydraulic equipment and generators are of European manufacture, India had to come half around the world to get the 100,000-volt transformers and switch gear of American manufacture. The transmission line, too, although not supplied from our own country, bears the American earmarks, towers 66 ft. high on 500-ft. spans with suspension insulators. The receiving station is on the island of Bombay and is another monument to American enterprise in transformer and switchboard construction. The switch-gear equipment is very thoroughly worked out with all the modern devices for safety. The market for the energy is very largely the cotton mills, where there are more than 40,000 looms and some 3,000,000 spindles. Up to the present these have been operated by isolated steam plants calling for 100,000 hp. Now the electrically transmitted energy from the hills will be available for all of them. The system of drive which has been adopted in the mills is the group drive which simplifies the motor service. The motors themselves, being fairly large, are mostly wound for 2000 volts, although some 500-volt machines are in use. Energy is sold at 1.65 cents per kw-hr. when the electric installation is wholly provided by the supply company and at 1.5 cents per kw-hr. when the mills furnish their own motors and equipment aside from the main transformers. Such prices look remunerative, even considering the great cost of the enterprise. Such are the main points of one of the most striking of recent hydraulic installations. Our readers will find its details well worth study.

The News of the Week

Activities and Events in the Electrical Field—Reports of Meetings—Commission Findings, Etc.

Boston Electrical Contractors Plan Get-Together Meetings

The Electrical Contractors' Association of Greater Boston is planning for the coming winter a series of "get-together" meetings along educational, social and co-operative lines. The first meeting was scheduled for Nov. 5, the speaker assigned being Mr. Alfred L. Cutting, manager of the Sheldon School of Scientific Salesmanship, Boston. The topic announced was "The Development of Human Efficiency," and more than 300 tickets were issued by the association, whose members employ several hundred wiremen and helpers.

Electrical Inspection for Kentucky Towns

The Kentucky Actuarial Bureau, of Louisville, Ky., an institution of the insurance companies doing business in the State, has organized a department of electrical inspection with Mr. George W. Gano as superintendent. Mr. Gano, who took charge Nov. 1, was formerly with the insurance firm of Marsh & McLennon, Chicago. Inspectors under the new department are stationed at Lexington, Covington and Owensboro, and with the aid of the men in the Louisville office will cover the entire State. Mr. Clem E. Wheeler, manager of the bureau, reports that in Kentucky educational work to show the public how to protect its property from electrical hazards has been badly needed. Every town inspected will hereafter have special attention from an electrical standpoint.

Water-Power Development on Skagit River

The Secretary of Agriculture has just granted to the Skagit Power Company a permit for the development of two water-power sites on the Skagit and Cascade Rivers in Skagit County, Washington, within the Washington national forest. It is stated by officials of the company that construction work on the Skagit project will be commenced within a comparatively short time. The construction will consist of a concrete diverting dam, 50 ft. in height, a tunnel conduit about 3.7 miles in length, and a power house on the Skagit River about 125 miles from Seattle. In developing power from the Cascade River the flow will be diverted by a concrete dam having a height of 20 ft. and a maximum length of about 200 ft. A flume and tunnel will carry the water a distance of approximately 6 miles to the proposed power house.

National Industrial Survey

The National Civic Federation, through its industrial economics department, has decided to undertake a survey of the industrial and social situation in this country, with a view to ascertaining whether or not recent decades have produced progress or retrogression. One of the features to be included in this work will be an examination of the principles involved in the movement for the abolition of private ownership in the means of production and distribution of wealth. An advisory council of well-known men and women from all parts of the country is to aid in carrying out this important work. The proposed investigation will include an inquiry into the factors concerned in the production of wealth, the methods by which the wealth produced is distributed among the several factors engaged in its production, and the effect of the existing conditions in the first two items on industrial, social and individual progress.

Proposed Rate Reduction in Chicago

Present electric-lighting rates in Chicago are based on a maximum tariff of 10 cents per kw-hr. and a secondary rate of 5 cents. As the result of the rate investigation of the Commonwealth Edison Company carried on by the City Council committee on gas, oil and electric light, Mr. Ray Palmer has found that a reduction amounting to about $636,000 a year can be made. Mr. Palmer has proposed that this surplus be distributed by the establishment of a tertiary or third rate, so that the standard rates would be 10 cents primary, 5 cents secondary and 3 cents tertiary. The company denies that the city has the right to regulate its rates, but nevertheless has been discussing the matter with Mr. Palmer and the City Council committee, and it seems probable that an agreement will be reached, either on the basis proposed or by making the tertiary rate 4 cents instead of 3 cents.

Investment Bankers at Chicago

The second annual convention of the Investment Bankers' Association of America, held at the Blackstone Hotel in Chicago on Oct. 28-30, was a well-attended and successful affair. Considerable attention was paid to papers and discussions relating to the public utilities securities and financial problems. The committee on public service corporations, of which Mr. George W. Kendrick, of E. W. Clark & Company, Philadelphia, was chairman, presented a very brief survey of the conditions of state regulation of public utilities in this country. It was stated that there are commissions in twenty-four states. The report was non-committal, saying that it was still too early to pass on the final result of the work of these state commissions. The committee has made a compilation of the laws of the various states having public-utility commissions.

Mr. Samuel Insull, of Chicago, gave an interesting address on "Electrical Securities." He explained to the bankers his ideas of the proper method of conducting electric-service utilities and said that the item of paramount importance to them in considering the securities was the development of the selling organization of the operating company. His main message was to say that bankers and public service operators make a very great mistake in opposing state regulation of public utilities.

Mr. Delos A. Chappell, of Los Angeles, read a paper on "The Financing and Development of Hydroelectric Power." He described the hydroelectric situation in California from the financial point of view, and said that in that State the water-powers developed are rated at about 500,000 hp. These are now owned by large corporations, and about 700,000 hp is awaiting development. Many of those which remain must wait until there is such an increase in demand as will justify the increased cost per unit

of horse-power development. The water-power development in California to-day is equal to about 1 hp per each six inhabitants. Mr. Chappell urged more rational methods of financing than those at present in vogue. He believes that first-mortgage bonds should be issued under what is termed an open-end or indeterminate mortgage. This avoids the objection of making a large issue long before the proceeds are required. Bonds may be issued from year to year during the full period covered by the indenture.

Mr. John E. Oldham, of Merrill, Oldham & Company, Boston, read a paper on "Public Utility Bonds," in which he showed by comparison with other forms of investment the stability and desirability of this form of securities. Mr. Oldham said that good public-utility bonds are first-class securities for investors.

Mr. George B. Caldwell, of the Continental and Commercial Trust and Savings Bank, Chicago, was re-elected president of the association.

At the closing banquet Mr. James J. Hill, St. Paul, uttered a note of warning in relation to almost unlimited bond issues. He said that there should be less spending for purposes that can wait and less borrowing on any terms. The country, he declared, is waterlogged with bonds and confidence cannot be restored until the name "bond" has gone back to something of its old standard.

International Society for Study of Radio-Telegraphy

At a meeting in Brussels on Oct. 13 a "Commission Internationale Scientifique de Télégraphie sans Fil" was established for the scientific study of radio-telegraphic waves and their phenomena. The president is Mr. W. Duddell, of London; the secretary, M. Robert Goldschmidt, of Brussels; the vice-president, Prof. W. Wien, of Jena.

On and after Jan. 1, 1914, at least until March 1, 1914, certain test messages will be sent from a station in Brussels at hourly intervals, on a wave length of 3300 m. Check measurements of the wave frequency, group frequency, power and other details will be made and recorded at Brussels. Observers are invited to measure these signals, as often, and at as many different places, as possible. It is hoped that national committees may be regularly appointed to co-operate in the movement, the objects of which are to increase the knowledge of electric radiation and meteorology.

The distance from Brussels to New York is in the neighborhood of 4000 statute miles, and to Chicago about 5000; so that the signals which one can hope to receive in this country from Brussels are likely to be very weak. However, if the limiting distance at which these signals can be detected is determined in America, that fact will have significance and utility.

Electrical Day at Dallas, Tex., to Be Made Permanent Feature

Such success attended Dallas' Electrical Day, held Oct. 31 in connection with the Texas State Fair, that the feature is to be continued as a permanent annual celebration. During the morning special trains brought hundreds of electrical men into Dallas from all parts of the State, but the Jovian parade in the evening, with its illuminated floats, flaring torches and weird decorations, proved to be the event of the day. Prominent in the procession were the floats of the Dallas Electric Light & Power Company, reproducing the throne of "Queen Electricity"; the Southwest General Electric Company, showing an electrically lighted skyline of Dallas, and the Albright Electric Company, which received first prize. An early horse-car with its old-time driver was exhibited by the Dallas Consolidated Electric Street Railway Company. Mr. R. W. Van Valkenburgh, grand marshal, was assisted by Mr. Leon Taylor, chairman of the parade committee, and Messrs. S. W. Davis, M. F. Sterett and W. J. Drury, marshals.

Following the parade a Jovian rejuvenation was held at which sixty-nine candidates were initiated into the order. The degree team, which occupied a float in the procession, was made up as follows: R. S. Wakefield, Waco, Jupiter; F. G. Caldwell, Houston, Neptune; E. F. Hall, Houston, Pluto; Tom A. Hunter, Dallas, Hercules; R. R. Farry, Dallas, Mars; E. A. Abbott, Dallas, Apollo; W. B. Head, Dallas, Vulcan; W. J. Drury, Dallas, Mercury; C. W. Thompson, Dallas, Avrenim, and B. Nelms, Fred L. Warner, Leon Taylor, R. W. Abright and Arthur Z. Barnes, imps.

At the joviation which followed the rejuvenation Mr. C. W. Hobson acted as toastmaster, and those who made addresses were Messrs. R. W. Van Valkenburgh, R. B. Stichter, J. E. Farnsworth, Edward T. Moore, W. W. Lowe and R. W. Abright.

Electric Automobile Salon at Boston

At a meeting of the Electric Motor Car Club of Boston Nov. 3 President Day Baker announced that the first electric pleasure-car salon to be held on a large scale in this country will be opened at the Copley-Plaza Hotel, Boston, Nov. 17, under the auspices of the club with the co-operation of the Boston Edison company. In the ballroom of the hostelry will be held an exhibition of the latest pleasure cars on a plane calculated to appeal to the society man and woman. An admission charge of $1 will be made to keep the display and its attendance within close lines of interest, although a number of complimentary invitations will be issued by the pleasure-car dealers of Boston and by leading central-station organizations in the metropolitan district. Mr. Herbert W. Moses will be supervisor of committee work, and the chairmen of the various committees are: Exhibition, Mr. W. H. Francis; publicity, Mr. L. D. Gibbs; printing, Mr. Albert Weatherby; reception, Mr. C. J. Hatch; finance, Mr. J. S. Codman; signs, Mr. L. R. Wallis; music, Mr. J. S. Codman; police and parking, Mr. C. F. Smith, and invitations, Mr. O. G. Draper. In addition to the exhibits within doors effort is being made to secure special parking facilities for electric automobiles in the Copley Square district during the salon, which will close on Nov. 19.

Boston-New York-Chicago Electric Automobile Run

What was perhaps the longest continuous trip ever made in an electric vehicle came to an end Oct. 31, when Col. E. W. M. Bailey, general manager of S. R. Bailey & Companyl, of Amesbury, Mass., arrived in Chicago in a Bailey roadster after a 1300-mile tour from Boston and New York. The car was equipped with a General Electric motor and sixty cells of A-6 Edison battery.

The travelers left New York City Sunday, Oct. 19, and during nearly the entire journey to Chicago the weather was unfavorable, high winds, heavy rainstorms, snow flurries and muddy roads being encountered. The trip was completed with no accident to the car nor failure of any part. While some of the days' runs were short and the speed slow, no better progress could have been made with a gas car. The car was mired four times, but came out under its own power in every case but one, when it ran off an embankment in the dark. Colonel Bailey reported that had weather conditions been good the run could easily have been made at an average speed of 150 miles a day. As it was, the average running speed up to Cleveland was better than 18 miles an hour.

Colonel Bailey was the guest of the Chicago Section of

the Electric Vehicle Association at luncheon at the Chicago Athletic Club on Nov. 1 and gave a graphic account of his trip. The distance covered by the car from Boston to Chicago was almost exactly 1300 miles. Central-station men were found to be uniformly courteous and obliging, but the charging facilities required were not always available without making special arrangements. In one case the vehicle was charged at a sawmill, and in another it was necessary to start up a 1200-hp engine in order to drive an exciter to get about 12 hp of energy into the little car. At Schenectady the car was charged from a mercury-arc rectifier using the new porcelain-lined iron tube.

The lessons of the journey seem to be that the electric vehicle is ready for touring, but that sellers of electricity should provide suitable charging means to meet the demands of electric tourists, which are rather more exacting than those of the operators of local electric cars. Facilities ranging from 40 amp to 200 amp should be sufficient for all requirements.

Instability of Electric Circuits

Following a practice of several years' standing Dr. C. P. Steinmetz, of Schenectady, gave his annual lecture in Chicago on Oct. 29 before a joint meeting of the Chicago Section of the American Institute of Electrical Engineers and the Electrical Section of the Western Society of Engineers. Mr. R. F. Schuchardt presided and presented Mr. L. A. Ferguson, past-president of the American Institute of Electrical Engineers, who introduced the speaker of the evening. Among other things, Mr. Ferguson mentioned Dr. Steinmetz's versatility and alluded to his recent activity in public affairs and his candidacy for president of the Common Council of Schenectady.

Acknowledging the hearty applause of the large audience present, the lecturer announced as his subject "Instability of Electric Circuits." He discussed various situations where conditions of instability make themselves felt in electric circuits. Three main types of instability may be distinguished: First, the transients of readjustment to changed circuit conditions; second, unstable electrical equilibrium, or the condition by which the effect of a cause increases the cause, and, third, permanent instability resulting from a combination of circuit constants which cannot co-exist.

The closing of a switch gives an example of transient instability in electric circuits. Transients intervene for a limited period, usually of very short duration, between periods of stationary conditions. The phenomena of these transients have been investigated to a large extent, but often by the use of the constants of the "phantom" circuit. Theoretical constants are not always the constants of actual circuits. An allowance should be made for this fact. For instance, if voltage is suddenly thrown on a line the wave at the beginning has a very steep front. Theoretically this steepness remains the same throughout the progress of the wave over the line, but in practice this is not the case. Oscillations in cables die out more rapidly than the equations show. There is a wide field for investigation of these transient phenomena.

The second class of unstable conditions, said Dr. Steinmetz, includes conditions where there is an unstable electrical equilibrium. If the effect brought about by a cause is such as to oppose or reduce the cause, the effect must limit itself and finally stability will be reached. If, however, the effect brought about by a cause increases the cause, the effect will continue with increasing intensity; that is, instability results. This principle applies not only to electrical phenomena but to all other physical phenomena. The speaker discussed unstable equilibrium as shown in variations of load and speed in the operation of various types of electric motors. In most cases electric circuits are stable, but there may be unstable circuits. Probably the most important case of unstable electric equilibrium is afforded by circuits containing an electric arc. This characteristic is determining in the stability of arc-lamp circuits and machinery and is possibly responsible for more instability in electric circuits than any other phenomenon.

Circuits with permanent and inherent instability were the third class considered. As an illustration an ungrounded high-potential single-phase transmission line was considered. Assuming that a ground is brought near one end of the line but within striking distance of the voltage to ground, a discharge is supposed to occur over some conductor, as by the puncture of a line insulator. Such an unstable circuit gives a continuous series of successive discharges.

Dr. Steinmetz illustrated his lecture with diagrams and devoted a considerable portion of his time to a consideration of the conditions of cumulative oscillation known as the hunting of synchronous machines. In the synchronous motor the torque is not a function of the speed but is a function of the relative position of the rotor to the impressed frequency. If the average synchronizing power resulting from the lag of the synchronizing force behind the position exceeds the average damping power, hunting results. The condition of stability of the synchronizing machine is that the average damping power shall exceed the average synchronizing power. The more this is the case the more stable is the machine; that is, the more rapidly the transient oscillation of readjustment to changed circuit conditions dies out.

Accidentally Opened Valve Wrecks 12,000-Hp Power Plant

An accidentally opened valve on the steel penstock supplying water under 450-ft. head to turbines being installed in the 12,000-hp Pioneer Power Station of the Utah Light & Railway Company at Ogden, Utah, on Oct. 26, burned out the loaded machinery, flooded the plant and carried away portions of the brick curtain walls. A large portion of Ogden was thrown into darkness for several hours and street-car service was stopped.

Two addition S. Morgan-Smith 3750-hp Francis turbines had just been installed by the Lynch-Cannon Engineering Company. These turbines are supplied through a 72-in. steel penstock with 24-in. double-faced Rensselaer motor-operated valves at the turbines. Each face was 7/8 in. thick, heavily ribbed. The 36-in. draft tube elbow had been removed from one of these turbines for inspection. The 24-in. motor-operated valve opened, allowing the water to rush past the wicket gates. This water cut the power from the motors which operated the valve, and with great difficult it was closed by hand. However, the rush of water carried away the rear half of the double valve and the front piece closed, holding the pressure for one minute; then it gave way, allowing the full flow through the 24-in. opening to continue for five hours, flooding the plant and burning out the loaded machinery.

The main intake pipe was protected by a Builders' Iron Foundry 42-in. valve. The seat of this valve was a bronze ring, which by some unknown means was broken and blocked the valve, allowing it to close about one-half. The main 72-in. steel pipe was protected by a 72-in. valve operated by hydraulic pressure. This valve closed until the pressure became balanced, leaving an opening of about 12 in. No hand valve being provided at this place, the main intake valve at the head of the 6000-ft. wood-stave pipe was closed by hand, requiring two and one-half hours. The motor operating this valve was cut off.

The station building is a steel-frame fireproof structure having brick curtain walls. All steel work and foundations are intact. No accurate estimate of the loss can be determined at the present time.

State Commissioners on Telephone Rates and Service

At a meeting of the National Association of Railway Commissioners, held in Washington from Oct. 28 to 31, a report was made by a committee on telephone and telegraph rates and service.

The report gives instances of telephone rates in cities where competitive conditions exist and also where monopoly conditions prevail and states that scientific rate-making has not been developed. Without question, the report continues, competition has been the means of the public receiving service at a lower cost, but this does not necessarily mean that the rates are either reasonable or remunerative. Many companies have entered the field of competition with low rates and in a short time found it necessary to get nearer the plane of their competitor, or, in some cases, the competitor has met the lower rate, this nearly always resulting in a consolidation of the two plants within a short period of time. A remedy for these conditions is being sought by both the public and the utility operators. There can be no question that duplicate plants in the same city are a waste of money and a public burden. State control of such utilities offers the best remedy for these conditions. Government control has not proved entirely successful. For example, the Japanese government had on March 31, 1911, 45,000 persons on the waiting list for telephone service. There are now twenty-eight states exercising control over telephone utilities.

The question of establishing a scientific basis for telephone rates is worthy of very deliberate consideration. Of the suggested bases of present worth or depreciated value, book value or replacement cost, the one that is receiving most favorable consideration generally at this time is the last-named. However, the committee deemed it best to refrain from making specific suggestion and left the matter open for general discussion or a specific report to be made by a special committee. The committee had little to say relative to telegraph rates and service further than that from investigation there was apparently less complaint against this utility than against any other.

Fessenden Wireless Patents Upheld by Court of Appeals

In a lengthy but exceedingly interesting opinion handed down on Oct. 20 by the United States Circuit Court of Appeals for the Third Circuit, in the patent infringement case of the National Electric Signaling Company et al. vs. the Telefunken Wireless Telegraph Company of the United States, written by Justice Buffington, the Fessenden United States patents Nos. 918,306 and 918,307 were upheld. These patents cover a method of wireless signaling and apparatus therefor, employing group impulses having a group frequency higher than commercially used alternating currents, but within the limits of audition. At the same time Fessenden's United States patent No. 928,371, relating to means for tuning the circuits of wireless apparatus, was held to be void for lack of inventive novelty.

The present case came up on appeal from the United States District Court for the Eastern District of Pennsylvania, where the plaintiffs lost. The decision of the lower court is now reversed, and the case is remanded for a new decree in accordance with the finding of the higher court, and also ordering an accounting.

The primary object of the invention described in the two Fessenden patents first named, for which applications were filed respectively on July 1, 1907, and Aug. 25, 1908, both issued on April 13, 1909, was the prevention of atmospheric disturbances in wireless signaling. The prior art consisted of employing a spark frequency corresponding to an exciting current having a periodicity of 60 cycles per second, or 120 sparks per second. Under such conditions the interferences caused by atmospheric disturbances or lightning were very troublesome and frequently made receiving impossible. That is to say, such disturbances excited the receiving circuit and interfered with the audition of received impulses from the sending station.

Blondel, in patent No. 824,682, described an attempted means of overcoming such troublesome effects by employing a higher spark or group frequency in conjunction with a tuned receiving circuit, but such means were found by experiment to be unsuccessful. Fessenden was the first to make practical use of Lord Rayleigh's discovery, in which he claims to have been a co-discoverer, that the human ear, instead of being uniformly sensitive to a wide range of disturbing frequencies, reaches a peak or maximum of sensitiveness at about 920 impulses per second, decreasing rapidly with frequencies above or below this limit. Accordingly he employed a correspondingly high spark frequency, but coupled it with an ordinary untuned receiver and relied upon the natural or physiological selective power of the human ear to distinguish the radio signals from the atmospheric disturbances which had hitherto been so troublesome.

As the testimony abundantly showed, his method was highly successful, and whereas the extraneous disturbances could be heard in the receiving telephone as before, the shrill pitch of the new signals proved to be highly penetrating and easily distinguished even in the presence of disturbances of greater volume than the signals themselves. An exceedingly interesting account was presented in evidence describing the first transmission of such signals of high group frequency from the Brant Rock (Mass.) station during the night of Dec. 11, 1905, and their receipt by an operator at San Juan, Porto Rico, who reported the matter to the Bureau of Equipment of the United States Navy. The bureau undertook at once an investigation to determine the source and character of these new and novel signals, finally locating the station whence they emanated. The commercial value of high-frequency spark signaling was attested both by several well-known experts and a number of radio-operators. It was also shown that whereas a tuned receiver would respond at its natural frequency when excited by atmospheric disturbances and thus interfere with signaling, an untuned receiver when thus disturbed would enable the operator to distinguish sharply between the noise or disturbance caused by atmospheric discharges and the characteristic high shrill pitch of the incoming signals, thus clearly establishing the value of Fessenden's combination of high spark frequency at the sending station and an untuned receiver at the receiving station.

Saturating the Dollar with Energy

Mr. Samuel Insull, president of the Commonwealth Edison and Middle West Utilities Companies of Chicago, addressed the convention of the Investment Bankers' Association of America in that city on Oct. 30, his subject being "Electrical Securities."

Early in his remarks Mr. Insull made the point that there are two classes of engineering influencing the electric-service industry. One is the mechanical and electrical engineering—that is, the engineering construction—and the other is first-class selling engineering. Referring to the first classification he exhibited curves to show the remarkable improvement in reduction of operating cost, comparing the relation of pounds of coal consumed to kilowatt-hours generated. From 1900 to 1904 the ratio of coal consumed in Chicago central stations to kilowatt-hour output was almost constant, but since then there has been a steady drop in the amount of coal necessary to produce a kilowatt-

hour. Only about 40 per cent of the coal burned per unit generated ten years ago is now required for the same output. To illustrate the engineering of selling, the speaker referred to a diagram showing that from 1896 to 1912 the business of the Commonwealth Edison Company had grown from about $1,000,000 a year to about $16,000,000, the latter figure being divided into $8,000,000 for lighting, a little more than $4,000,000 for industrial motor service and a little less than $4,000,000 for energy for transportation purposes. Curves were also given to show the reduction in rates for electrical energy in Chicago. Improvements in lamp efficiency helped decrease the cost of electric light.

Mr. Insull spoke of his work of the last ten years in relation to the wholesaling of energy in very large quantities, and he described the fight that has been made and is still being made to fill up the valleys in the load curve. Backed by the courage of a body of investors which has stood behind him for more than twenty years in Chicago, Mr. Insull has been enabled to try out several experiments, with the result that he has been able to bid for classes of business not until recently supposed to be handled by electric-service companies. The problem is to keep the investment working for as many hours of the day and as many days of the week as is possible. About 1902 this effort to fill up the valleys as much as possible was begun, and it was so successful that by 1912 the Commonwealth Edison Company was using its investment 31 per cent more of the time than ten years before. Notwithstanding what has been done in Chicago, it is probable that the company still performs only one-third to one-half of the possible electric-service business of the city. If the business is to be developed to the saturation point in other communities as well as in Chicago, the enormous amount of money that will be required to take care of the investment necessary can be imagined.

In the production of electrical energy the greatest item of expense is not the cost of labor nor the cost of coal, but the cost of money. First-class selling engineering makes it possible to get useful work from the dollar of investment for the longest possible time. Mr. Insull made the interesting statement that he thought that if he had to choose between first-class construction engineering and first-class selling engineering he would select the latter, as it would give him the use of more money on the dollar invested with which to make up for possible mistakes made in constructing engineering. The item of paramount importance in the financial aspects of the electric-service industry is not the replacement value of the central station or the distribution system, but it is the assurance that the selling organization of the company under consideration is of the highest possible order. Mr. Insull advised his hearers when dealing with the securities of a company to see to it that the methods are of the most enlightened nature so far as the selling of the product is concerned.

In the supplying of electricity the tendency is toward conservatism of investment. This fact is illustrated by statistics which show that in 1898, when the Commonwealth Edison Company had something over 5000 customers, the investment per customer was $1,579. In 1912 the number of customers was nearly 180,000 and the investment per customer had dropped to $417. In 1898 the annual gross income per customer was $210 and in 1912 it had dropped to $87. Elucidating these figures, Mr. Insull made a striking statement when he said: "While steadily reducing our price and endeavoring to put ourselves in closer accord with our customers, we have at the same time produced a greater saturation of the dollar with energy." The gross income was 13.5 per cent of investment in 1898 and 21 per cent in 1912.

Another interesting curve showed that from 1896 to 1900 the company was selling on the average energy that cost it about 12 cents per kw-hr. for a little over 10 cents. Nevertheless, the company made a profit, and this fact was largely due to the policy existing at that time of selling and installing isolated plants. However, it is a fact that at the time mentioned the company did not really know what it was costing it to produce electrical energy. At that time central-station companies knew so little about their business that they did not really know how to figure cost.

"If I were judging of the character of securities," said the speaker a little later, "I would lay the greatest stress on the general information which could be obtained in relation to the business policy, the ability to sell the product properly and the ability to get the best results out of the smallest amount of money invested."

Mr. Insull then went into the consideration of the diversity factor to show the advantages of concentration of production in supplying a large area with different demands, as, for instance, the State of Illinois. If the lighting business, local and interurban railways, ice-making plants, coal-mining, water-works pumping, drainage pumping and so on are supplied from the same source of energy, striking economies can be effected by utilizing the diversity factor. Small, uneconomical plants are bound to disappear. Securities based on these small plants must be taken care of, of course, but centralized operation offers such a greatly extended field for industrial activity that it is possible to do this and also issue the new securities founded on the new business and the economies that may be effected by extended consolidation. Further, it is usually the case that small country properties are poorly constructed and inefficiently operated. Their absorption into the large system means better service for the community at a lower price. This in turn means increased popularity in the local centers and appreciation of the necessity for new securities.

In relation to holding companies, Mr. Insull said that the great danger here is the multiplication of securities and the creation of so-called prior-lien securities of the holding company based upon the junior securities of the operating company or companies. If the deed of trust underlying the collateral trust securities is rigid enough to protect the purchaser against the creation of a large floating debt by the operating company, there is no reason why the stocks of operating companies should not be put up as security for collateral trust bonds of holding companies. But this subject is one that deserves very serious consideration on the part of investment bankers. The mere creation of paper securities does not add anything to the actual cash invested in the companies. The dealer in securities ought to be fully posted as to the value of the property mortgaged and the relation of that value to the gross and also to the net income. If the difference between the gross and the net income is very great, the banker should look carefully into the relation that the company issuing the securities has with the community in which it operates.

Mr. Insull spoke earnestly also in relation to the subject of regulation of public utilities. He thinks that regulation is the best thing that can possibly happen to the industry. He quoted from his presidential address of 1898 to the National Electric Light Association, in which he advocated public control as the proper safeguard to the interests of consumers, taxpayers and investors. In the fifteen years that have elapsed Mr. Insull has not changed his opinion. Generally speaking, the creation of the numerous state public-utility commissions has been for the good of the industry and for the good of the securities based on the industry, as well as the good of the people in the communities served. In the principal cases where regulation has seemed to be unfriendly it will no doubt often be found that the men in control of the property have not had a proper appreciation of the underlying principles governing the business. When an administrative board gets to understand its task, if it is made up of honest men it will give the utilities a fair return on the money invested provided that money has been judiciously spent and provided the business is judiciously conducted.

The great crime and waste of competition must be brought home by the establishment of commissions or some other form of regulation on the part of the various states. On this point Mr. Insull said: "My main message in speaking to the investment bankers of this country is to say that they and men in positions like myself make a very great mistake in opposing the fair regulation of an industry which can only be run as a monopoly, and no business should be run as a monopoly without a fair oversight on the part of the State."

The closing words of the address were devoted to the stability of electric-service investments. Mr. Insull said he did not recall any case where scrapping on the part of first-class engineers had ever been more than 25 per cent of the value of the property. The general tendency is toward increase in the value of materials entering into plant and equipment. Investors have little or nothing to fear from even such drastic scrapping as must necessarily take place in absorbing a series of isolated community plants into a large central system operating over a wide area.

Mr. Insull was heartily applauded by the bankers, and a rising vote of thanks was given to him.

Relation of the Bureau of Standards to Commissions

In an address delivered before the National Association of Railway Commissioners at Washington on Oct. 29, Dr. Edward B. Rosa, chief physicist Bureau of Standards, gave an outline of the work of the bureau and of the directions in which it hopes to co-operate with state public service commissions.

Dr. Rosa said that the bureau has been making a study of some of the problems in public utility regulation, partly in response to a demand from the state commissions and cities which (in the absence of state commissions) regulate their own utilities, and partly in response to a demand for information from the operating companies and from engineering societies which are largely made up of representatives of such companies.

One of the first of these problems studied was the preparation of specifications for the quality of illuminating gas and gas service and methods of testing such gas. The results of this investigation are embodied in two publications, one recently issued in its second edition and the other now about to be sent to press. In the course of this work, in which the bureau had the co-operation of many of the most experienced gas engineers in the country as well as of several representatives of cities and state commissions, the problem was studied from the standpoint both of the user and of the maker of the gas. In fixing the heating value it was necessary to inquire what is the most economical quality of each different kind of artificial illuminating gas to make, assuming that the price is to be proportional to its heating value, within the range of heating value that will give good service. This study brought up the whole subject of gas making and gas distribution, as well as the testing for chemical impurities and heating value and candle-power. It demonstrated that it is not practicable intelligently to fix requirements for quality and service without taking full account of economic conditions and the variation of such conditions from place to place and from time to time. A thorough investigation was also made of the standards used for testing the candle-power of gas, and of the instruments and methods employed in taking the heating value of gas.

Another investigation that has yielded results of great practical importance, Dr. Rosa said, concerned the electrolytic corrosion of gas and water pipes and lead cable sheaths by earth currents due to electric railways. The bureau has made a very thorough study of the various proposals that have been made for applying protective coatings to such pipes and also for protecting them by bonding to negative busbars and by using insulated negative feeders from the track itself. In the course of this investigation the engineers of the bureau have made field examinations in many cities, both large and small, and with the co-operation of the gas, water, telephone and railway companies examined the pipes and made electrolytic surveys of earth currents. A complete system of electrolytic mitigation has been worked out for two cities and is being put into operation. The work has progressed far enough to demonstrate that the method may be successfully applied in many cases. This is a matter of great practical importance because hundreds of millions of dollars' worth of underground pipes and cables are subject to damage by electric railway current, and the bureau believes that the public service commissions can render a great service by seeing that the railways take such precautions as to reduce this damage to a minimum.

Such questions should be kept out of the courts entirely, and the bureau believes that when the engineering aspects of the subject are better understood street railway companies will generally be ready to co-operate with the public service commissions and to remove, as far as possible, the cause of the trouble. In two of the cities studied by the bureau it was found that the saving of electric power effected by the methods of mitigation proposed was enough to pay a fair return on the entire cost of the changes and new construction required, and the systems will be in better operating condition for the change. The work was conducted as a scientific investigation, although it was done in a thoroughly practical way and all conclusions verified by frequent reference to working conditions.

Another investigation of great practical importance recently undertaken is on the life hazard in electrical work. Manufacturers can help by improving the design and construction of certain kinds of apparatus; constructing engineers can help by using better materials in many cases and installing dangerous apparatus with greater thought of the life hazard; operating companies can help by educating their employees and by adopting stricter rules for their protection and providing them with more and better safety appliances; public service commissions and city authorities can help by adopting better regulations and having frequent inspections; the press can help by creating public sentiment in favor of attaching greater value to human life and warning the public of the danger. The operating companies and electrical engineering societies are cordially assisting the bureau in this investigation, and the bureau hopes to place some preliminary results in the hands of the public service commissions at an early date.

Another investigation of practical bearing to the public service commissions is on the instruments used in electrical measurements and the methods of testing. The traveling inspectors employed by the state commissions render the companies and the public great service by checking up the master meters of the stations. These meters are usually not very portable, and traveling inspectors who are prepared to test them and to give local inspectors information and assistance in their work render an important service.

For the lack of a sufficiently large scientific and engineering staff, the bureau has been unable to do as much as it would wish and has been unable to give the assistance to some of the state commissions which it has been asked to give and should have been very glad to give if possible. It is hoped that by another year the resources will be greater, and that the bureau can take up in a thorough and scientific way many other problems connected with the public utilities.

One of the most serious objections that have been urged to the regulation of public utilities by commissions is that if the same rate of return on the capital invested is allowed to all companies it removes in many cases all incentive to the responsible officers of utility companies for enterprise,

hard work and economy, and that in consequence both the public and the stockholders are losers and great injury is done the industries. As yet so little experience with rate-making has been had that one cannot say perhaps whether this has already occurred in some degree or not. Nevertheless, this is a tremendously important consideration, and it must not be ignored.

Dr. Rosa called attention to the fact that the California Legislature recognized the importance of the matter and provided for it in the public utility act of 1911 in the following paragraph:

"Nothing in this act shall be taken to prohibit any public utility from itself profiting, to the extent permitted by the commission, from any economies, efficiencies or improvements which it may make, and from distributing by way of dividends or otherwise disposing of the profits to which it may be so entitled, and the commission is authorized to make or permit such arrangement or arrangements with any public utility as it may deem wise and for the purpose of encouraging economies, efficiencies or improvements and securing to the public utility making the same such portion, if any, of the profits thereof as the commission may determine."

The State of Idaho embodied the same paragraph in its recent public utility law, and the still more recent Pennsylvania law expresses the same idea in the following language:

"It shall be lawful for every public service company . . . to participate, to such an extent as may be permitted by the commission and deemed by the commission wise, for the purpose of encouraging economies, efficiencies or improvements in methods or service, in additional profits which may be afforded by such economies, efficiencies or improvements in methods or service."

These are clearly just and wise provisions if they can be realized. But the question at once arises, How shall the public service commission decide whether a given company has made such economies, efficiencies and improvements as to entitle it to additional profits? Standards of efficiency and economy must be set, and a given company claiming to have considerably exceeded the average and asking to be allowed to pay dividends higher than the normal must be judged by such standards. On the other hand, if a company is poorly managed, its performance will show it when measured by the same standards. Such a system would tend powerfully to promote economy and enterprise, and yield large benefits to the stockholders and the public. It is a flexible and just sliding scale, but to carry it out successfully requires an exceptionally well-equipped commission. Its realization would certainly constitute a long step toward the scientific regulation and control of public utilities.

But few state commissions can maintain engineering staffs large enough and able enough to do all that is required to realize such a scheme. If, however, the states could co-operate effectively in this work, so as to utilize their combined resources most efficiently, and with the federal government assisting and co-ordinating the work, it is possible that standards of economy and efficiency could be set and operating data determined that would be of vast service not only in enabling the commissions to act more intelligently and more justly but also in securing greater uniformity of action among the various commissions. The bureau hopes to be in position soon to do something in this direction.

To carry forward and develop the work of regulation in all the states will require the same constructive ability and the same earnest thought and hard work as have been displayed by those who have pioneered the movement. Without it, Dr. Rosa added, failure may follow, with a reaction in the public mind concerning the success of regulation by commission. With it success is assured from the outset in far greater measure than has yet been realized anywhere. The benefits are not merely the material advantages accruing to the utilities and to the public which is served by the utilities, but also those accruing to the cause of good government and to business and political ethics.

The relation of the Bureau of Standards to the public service commissions is unlike that of the Interstate Commerce Commission in some respects and like it in others. It is like it in representing the federal government and in co-operating with the state commissions and striving to bring the latter closer together. But it has no legal authority over the utilities, holds no hearings of complaints and renders no binding decisions. Its work is primarily scientific investigation, some of which is theoretical and refined (such as fixing of primary standards and methods of measurement) and some is very practical and concrete, and includes many of the most interesting problems of present-day engineering. Dr. Rosa believes that there is an immense opportunity for usefulness in assisting to solve some of the problems presented by the public utilities, co-operating in this work with the state commissions and assisting them as far as possible to get full and reliable information, but not assuming any responsibility that belongs to them nor interfering in the slightest degree with their freedom of action. The bureau will thus serve in some measure as a clearing house for technical information and in some degree as an agency for scientific and engineering investigations.

The Bureau of Standards is still young and has not yet a complete equipment for all lines of work. Nevertheless, it is the largest national standardizing laboratory in the world and in many lines of work has an unrivaled equipment.

Relation of Surplus to Rate-Making

Mr. F. E. Barker, chairman of the Massachusetts Board of Gas & Electric Light Commissioners, read a paper on the "Relation of Surplus to Rate-Making" at the meeting of the National Association of Railway Commissioners in Washington on Oct. 30. The paper was part of the report of the committee on railroad taxes and plans for ascertaining fair valuation of railroad property. In large part the report dealt with the general subject of valuation rather than with that of railroad valuation alone.

Mr. Barker said that whatever may be true under ideal conditions, it may be noted that in ordinary practice neither the existence nor the amount of surplus can be reliably determined by a cursory inspection of the company's balance sheet. "Surplus" there is found in the list of liabilities and is merely the difference between the total assets and the total liabilities as there stated. Either of the terms "assets" and "liabilities" may cover a multitude of sins. Items of property among the assets may be carried at figures above or below their actual value, according to the purpose and policy of the corporation. The list may include items of no real value, items which are mere fictions of accounting, or even those which indicate liabilities in suspense. It may or may not include those permanent additions to the plant which have been paid out of profits, or the unearned increment of value, either of which is sometimes of substantial importance. Neither, on the other hand, is the real surplus to be diminished or dissipated by liabilities, whatever their title, which are the mere creation of the accountant and are in fact only divisions of the actual surplus, whether appearing as capital stock or some other equally elusive designation. The analysis of the balance sheet suggested as necessary for the discovery of the real surplus involves no implication of intentional fraud or deception, since the actual conditions result more often from some theory sincerely held as to proper corporate methods or policies born of certain opinions as to business necessities or corporate rights.

A prudent management, even when considering only the

interests of the shareholders, will rarely divide among them all the annual profits, said Mr. Barker. Where it is considered inexpedient to issue new securities for plant additions unless such plant will add appreciably to earning power, conditions may arise that will call for investment in plant out of profits. Prices are fixed in advance and based upon certain expectations, while unexpected conditions of prosperity and growth may develop profits to which the management is unwilling to invite immediate public attention through a dividend declaration. Only a moderate amount annually so retained will in a series of years reach a considerable sum. Even where rates are determined by governmental authority, it is doubtful if they can practically be safely made with such closeness to expenses and maintenance as to prevent, under ordinarily competent management, the acquiring of a surplus unless it be dissipated in unreasonably or unexpectedly high dividends.

The conviction now widespread of the necessity of governmental regulation is ample evidence of public acceptance of the failure of the competitive theory for the adequate control of such concerns, and of their position as virtual monopolies. It is by no means certain that, under the schemes of regulation over steam railroads now so imperiously demanded by the public, some pooling arrangement, which of itself implies monopoly, may not be found essential, even where competition now apparently exists, to effect a proper public regulation.

By public service company is to be understood, Mr. Barker continued, not only a company bound to serve the public generally, but one performing a service which the public, or some political division of it, might perform for itself if it should deem such a course expedient for the public interest. When profit is to be received, but its amount is not fixed, from the very nature of the grant the mutual expectation must be assumed that the affairs incident to service will be managed with economy and efficiency, and that the compensation in the form of divisible profits will be fair and reasonable, but no more. The proposition may not have been formally considered in every case, but if considered at all could be stated in no other way. If more than reasonable compensation is in fact obtained, the public has to that extent been overcharged for the service furnished, although it may be not with deliberate intention. The fact of the surplus implies that this overcharge has been retained in the possession of the company. Where for any reason it has been dissipated or has disappeared is not the situation under consideration.

It may be at once conceded that the company is in the full possession and enjoys the legal ownership and use of this surplus and cannot be deprived of either. It may well be that its existence may be due largely to the skill and good judgment of the management itself. But, on the other hand, it should be noted that the actual direct contributions by the shareholders from their own individual funds compose no part of what is here termed surplus.

The practical problem necessarily arises as to how far the existence of a surplus creates new rights or new duties, either on the part of the company or of the public, with respect to the making of rates. There is a prevailing view that rate-making is properly, and in a monopoly necessarily, based solely on cost, and that a primary factor in that cost is the value of the property requisite to perform the service. Accordingly it is assumed that in fixing a reasonable rate, whether in the first instance by the company or upon proper proceedings by a public commission, an essential prerequisite is the determination of the amount and value of the property employed in performing the service. Viewed merely from this standpoint, no consideration of surplus as such enters into the problem, except that a rate so made is reasonably certain to produce a new surplus.

A surplus should be retained in the company's assets, Mr. Barker added. To distribute it among the shareholders would be as unjust to the public as any attempt by the public to wrest it from the company would be unjust to the shareholders.

In the present consideration it is immaterial whether surplus has been acquired in the ordinary and natural conduct of the business without special intent, or whether it has been deliberately obtained through charges made for the express purpose of its acquisition. Local conditions make inflexible rules for the use of the surplus impracticable, almost certainly inadequate, perhaps impossible. Much can often be properly used to extend and improve the service where the prospect of an immediate normal return upon the expenditure required cannot be clearly seen, yet where the convenience of the public will obviously be served. It may be used to encourage or aid in the development of new processes or methods of business, the wisdom of whose adoption can be conclusively determined only by actual experience. It may also facilitate reductions in rates where, in view of the ever-present possibility of changed conditions, there may be some lack of certainty as to what the result of a given rate will be.

Its existence will undoubtedly give added security to regular dividends, and it may even be used in part at least to increase, without prejudice to the public interest, the otherwise reasonable rate of return upon the actual investments by the shareholders from their individual funds. The existence and acquisition of such a surplus may, therefore, prove highly advantageous both to the company and the public, so much so that the public may find it expedient, reasonable and profitable to encourage by a proper recognition in the amount of divisible earnings permitted that quality of management which, while just to the public, will promote its development. While its existence should not be imperiled, unless with the promise of some advantage to the public, neither should it in any event or under any conditions be the instrument of increasing the otherwise reasonable burden upon the public.

Mr. Barker expressed the opinion that upon the various boards and commissions charged with the duty and responsibility of regulating these corporations must devolve in large measure the difficult task of determining those equities which are consistent with a sound public policy. Those which are involved in the treatment of the surplus are by no means the least of these. It must be the recognized duty of these boards to hold the scales of justice in equal poise with the company and the public with no purpose to embarrass or oppress and with no attempt to be vindictive on account of past corporate transgressions.

A liberal recognition by the management of the corporation of its public duty in respect to its accumulated surplus would undoubtedly be met by a more liberal public attitude to be evidenced in the action of regulatory boards. Properly understood and applied the principles involved will not hinder but, rather, stimulate enterprise and progress.

If it be claimed that this proposition vests too great authority and discretion in the regulating boards, it must devolve upon those who make the claim to show some other way by which a just relation can be attained.

From his own observations Mr. Barker did not hesitate to say that the correctness of the principles suggested herein was fully recognized a quarter of a century ago by the dominant interests in the public service companies of Massachusetts, nor it is altogether absent from the policies of many of the companies of to-day.

Other papers presented in connection with the report of the committee were by Dr. A. F. Weber, chief statistician New York Public Service Commission, First District, on "Depreciation and Its Relation to Fair Value"; by Dr. Robert H. Whitten, librarian-statistician New York Public Service Commission, First District, who discussed decisions on the subject of valuation issued by that commission; by Mr. Max Thelen, member of the California Railroad Com-

mission, on "A Just and Scientific Basis for the Establishment of Public Utility Rates"; by Mr. George A. Henshaw, member of the Oklahoma Corporation Commission, on "Elements of Appreciation in Railroad Valuations"; by Prof. Edward W. Bemis, of Chicago, on "The Accounting Side of Rate-Making," and by Mr. Halford Erickson, member of the Railroad Commission of Wisconsin, on "Relation of Fair Return to Fair Value."

Acceptance Tests of Watt-Hour Meters in New York

New regulations governing the acceptance tests of watt-hour meters have been issued by the New York Public Service Commission, First District. They took effect on Sept. 30 and superseded the rules prescribed in an order entered by the commission on June 25, 1909. In the preparation of the revised rules the commission states that it was substantially aided by the work done by the joint meter committee of the National Electric Light Association and the Association of Edison Illuminating Companies. In the course of the preparation of the revised rules it was pointed out that should they be adopted by commissions in other states, as has been done in the past, they would include many types of meters now in use by the operating companies, which were approved under the original specifications adopted by this commission and which are still in use in the First District of New York. In order to obviate any such results the commission provided that the revised rules and regulations should not be deemed to be retroactive, but should apply only to watt-hour meter types hereafter submitted for approval.

The specifications for accuracy of direct-current meters provide for seven tests, relating to initial accuracy of registration, effect of variation in voltage, equality of elements in three-wire meters, effect of external magnetic fields, effect of variation in temperature, effect of temporary overloads, and voltage drop in series coils. The provisions governing the test for initial accuracy of registration are as follows:

"Item No. 1. None of the meters shall creep with 110 per cent of calibrated voltage.

"Variations in accuracy:

"To pass successfully test No. 1, the accuracy of a meter, after running for at least one hour with 10 per cent of rated load, shall not deviate from 100 per cent by an amount exceeding that specified below.

"Conditions: The test shall be made at calibrated voltage."

Item No.	Percentage of Rated Current	Maximum Deviation from 100 Per Cent. Shall Run Continuously
2	2.0	
3	5.0	7.5
4	10.0	3.0
5	20.0	2.0
6	50.0	2.0
7	100.0	2.0
8	150.00	2.0

9—The difference between the accuracy at 10 per cent rated current and that at 100 per cent rated current shall not exceed 3 per cent.

The specifications for accuracy of single-phase induction meters provide for nine tests. The two in addition to those provided for direct-current meters are effect of variation in power-factor and effect of variation in frequency. The specifications for the test of initial accuracy of registration are as follows:

"Item No. 1. None of the meters shall creep with 110 per cent of calibrated voltage.

"Variations in accuracy:

"To pass successfully test No. 1, the accuracy of a meter after running for at least one hour with 10 per cent of rated load, shall not deviate from 100 per cent by an amount exceeding that specified below.

"Conditions: The test shall be made at calibrated voltage, rated frequency and unity power factor."

Item No.	Percentage of Rated Current	Maximum Deviation from 100 Per Cent. Shall Run Continuously
2	2.0	
3	5.0	3.0
4	10.0	1.5
5	20.0	2.0
6	50.0	2.0
7	100.0	1.5
8	150.0	3.0

9—The difference between the accuracy at 10 per cent rated current and that at 100 per cent rated current shall not exceed 1.5 per cent.

Specifications are also provided for the accuracy of polyphase meters.

Commissioner Milo R. Maltbie, in an opinion accompanying the order, says that the progress in the art of manufacturing watt-hour meters has been so rapid during the past four years that the requirements outlined in the previous order may now be revised and made more stringent.

These rules have been prepared by Mr. Clifton W. Wilder, the electrical engineer of the commission, with the assistance of other engineers in the department. The joint meter committee of the National Electric Light Association and the Association of Edison Illuminating Companies has made many suggestions that have been of great value and assistance. Extended use has also been made of the meter code of these two bodies.

Mr. Maltbie adds that the rules and regulations submitted should apply to all types of meters hereafter submitted for the approval of the commission. They do not require that meters installed with the approval of the commission should be removed. The order is not retroactive in effect, and, if any action is taken regarding the removal of meters now in use which do not measure up to these specifications a separate order should be adopted.

Public Service Commission News

Massachusetts Commission

The Postal Telegraph-Cable Company has filed a complaint with the Massachusetts Public Service Commission against the New England Telephone & Telegraph Company, alleging that the latter, as a subsidiary of the American Telephone & Telegraph Company, is improperly diverting business to the Western Union Telegraph Company. It is contended that the New England company has purposely been delaying telephone connections requested by would-be patrons of the Postal company and has discriminated in favor of the Western Union company. The complainant urges that the identity of the telegraph companies be concealed in listed numbers in the telephone directory, and that patrons be required to look up the name and number of the desired company in dispatching messages.

New York Commissions

According to the reports of the engineers of the Public Service Commission for the First District, there is now under contract $83,000,000 worth of work on the new subway lines of the dual system of rapid transit and an average daily force of 7000 men employed thereon. Of the $83,000,000 worth of work, about $38,000,000 is on lines to be operated by the Interborough Rapid Transit Company and $45,000,000 on the lines to be operated by the New York Municipal Railway Corporation. Of the latter, however, the Fourth Avenue subway in Brooklyn and the Centre Street Loop subway in Manhattan, costing together about $28,000,000, are practically completed. It is

estimated that the construction work on the city-owned lines will cost about $200,000,000. There is, therefore, more than one-third (to be exact about two-fifths) of the value of this work already under contract. Of the remainder, to cost $117,000,000, it is expected that more than one-half will be under contract before the end of the year, so that by that time, nine months after the signing of the dual system operating contract, actual construction work will be in progress on three-quarters of the city-owned lines.

WISCONSIN COMMISSION

The Wisconsin Railroad Commission has authorized the Water & Light Commission of the city of Fort Atkinson to amend the rate schedule prescribed by the commission for certain classes of consumers. The rates for power and heating consumers whose load is connected for six months or less are to be increased by 10 per cent of the fixed charge on the active connected load, except in cases where the consumers agree not to use power at times of peak load and take satisfactory measures to prove such times of use. Under the rates as amended, all consumers of a temporary nature who cannot be expected to be liable for the reconnection charge must pay for energy at the primary rate. The city is authorized to charge the same rates for heating and cooking as were authorized for power service. Where energy is used for such purposes, the active connected load is to be 90 per cent of the first 2 kw of nominal rated capacity, 65 per cent of the next 3 kw and 50 per cent of all connected load in excess of 5 kw.

The commission has denied the petition of the Ettrick Telephone Company for authority to extend its lines into the town and vicinity of Glasgow. The extension was opposed by the Western Wisconsin Telephone Company, which now serves the territory. The commission's investigations showed that a considerable portion of the Western Wisconsin Telephone Company's subscribers were urging the extension with a view of taking service from the petitioner because of the lower rates. It developed that the exceptionally low rates offered were made possible by an inadequate depreciation fund, the payment of low wages and the failure to keep up the system in first-class shape. The Western Wisconsin Telephone Company is earning about 7 per cent on its investment and is furnishing excellent service but could not afford to reduce its rates, as would be necessary if it had to compete with the petitioner. The commission held that the low cost of service on the part of the petitioner was not a sufficient justification for its entrance into the field as a competitor.

The La Crosse Gas & Electric Company has been authorized to issue $126,000 in 5½ per cent bonds. The proceeds are to be used in the rehabilitation of the plant, the purchase of new units and repairs and extensions for the hot-water-heating system. The total cost of new improvements is estimated at $157,609.

INDIANA COMMISSION

Mr. Thomas C. Duncan, chairman of the Public Service Commission of Indiana, has just completed negotiations with Mr. Gilbert H. Hendren, state examiner of the Indiana State Board of Accounts, which have resulted in the establishment of a specific dividing line between the operations of the two big state departments in regard to investigations of all municipally owned utilities in the State. The commission's activities with regard to any investigation of municipal utilities that may be made will be devoted specifically toward collecting statistics for rate-making or service problems, and the particular city fund that any particular account is paid from will not enter into the commission's consideration, except as it affects rate-making or service. The commission in its statistics pays strictest attention to the unit of cost, the resultant rate and the service; the State Board of Accounts treats the situation entirely from a bookkeeping standpoint.

Current News Notes

CHICAGO VEHICLE-CHARGING REVENUE $200,000.—During a recent twelve-month period the income of the Commonwealth Edison Company from vehicle-charging service alone was $200,000. For the preceding year this revenue amounted to $130,000.

* * *

WINNIPEG'S MUNICIPAL HYDROELECTRIC PLANT.—At the recent "municipal dinner" of the Chicago Association of Commerce Mayor T. R. Deacon of Winnipeg, Manitoba, said that his city had invested over $6,000,000 in its municipal hydroelectric plant. He added that the development was for 100,000 hp and that the city was able to sell energy to its citizens at 3 cents per kw-hr. If energy is taken in large quantities and under favorable conditions, the rate goes down to less than 0.5 cent per kw-hr.

* * *

CHATTANOOGA & TENNESSEE RIVER POWER COMPANY'S STATION COMPLETE.—On Nov. 13 the station of the Chattanooga & Tennessee River Power Company at Hales Bar on the Tennessee River near Chattanooga will be formally opened. The occasion is to be celebrated in Chattanooga with much pomp, government officials in high places having promised to take part. The development, which was started by the late A. N. Brady, is the largest in the South and represents an investment of approximately $9,000,000. It is rated at 65,000 hp.

* * *

LITTLE FALLS, MINN., CELEBRATES.—Little Falls, Minn., gave a "white way and home-coming" celebration on Oct. 25. The celebration was in honor of the "white-way" lighting on Broadway, Second Street and other streets installed by the Little Falls Water Power Company. The system consists of 108 posts, each supporting five tungsten lamps. Sixteen city blocks are lighted in this manner. The rate paid to the company is $3.50 per month per post. Governor Eberhart attended the celebration and spoke in favor of the proposed public utilities commission for Minnesota. Mr. T. C. Gordon, of the Little Falls Water Power Company, was one of the other speakers.

* * *

DR. STEINMETZ ON RAILROAD ELECTRIFICATION.—Two hundred and eighty men attended the meeting of the Electric Club of Chicago on Oct. 30 to hear Dr. Charles P. Steinmetz. In meeting objections which sometimes are made regarding the substitution of electric locomotives for steam, Dr. Steinmetz said that the former are economical only in large sizes, while electrical operation is most satisfactory where the load to be hauled is distributed among several trains whose schedules are arranged to produce a high load-factor. The development of a new product does not necessarily require the replacement of the old, but requires the reconstruction of old methods to conform with the new idea. In substituting electric locomotives for steam this idea should be carried in mind.

* * *

INSPECTION OF COON RAPIDS PLANT.—By invitation of General Manager R. F. Pack of the Minneapolis General Electric Company, the Mayor and other officials of that city inspected recently the Coon Rapid hydroelectric development now under construction by H. M. Byllesby & Company on the Mississippi River near Anoka, Minn. The visitors were surprised at the magnitude of the work and the progress made and praised the modern methods employed for the housing and care of the large construction force. On Oct. 14 the Minneapolis General Electric Company made a new high record of output, the figure being 347,930 kw-hr., and as the business is increasing rapidly the additional energy that will be obtained from the new hydroelectric plant is needed.

Liberty Raises Its Voice.—The town of Liberty, Ind., has complained to the Public Service Commission of Indiana that it is required to pay more for electrical energy for street lighting than the neighboring town of West College Corner, although the electricity, as alleged, is obtained from the same source. The town of Liberty is supplied by the Liberty Light & Power Company, and it is charged that the same company, in the name of its president, Mr. Robert S. Ashe, is giving service to West College Corner. The complaint alleges that the source of energy in both cases is a generating station at Richmond, which is 14 miles from Liberty and 20 miles from West College Corner. It is said that the rate in Liberty is $4 a month for each 50-cp street lamp, while for corresponding service in West College Corner the rate is $3 a month.

* * *

SOCIETY MEETINGS

Colorado Electric Club.—Lieut. Ernest A. Brooks, U. S. N., addressed the Colorado Electric Club at its luncheon held at the Albany Hotel, Denver, Oct. 30, on the topic of "Uses of Electricity in the Army and Navy." Lieutenant Brooks was formerly on the electric-driven collier *Jupiter*.

* * *

Oregon Contractors' Next Annual Convention.—The next annual meeting of the Oregon Electrical Contractors' Association will be held in April of next year. The officers of the state association are: President, Mr. R. G. Littler; secretary, Mr. F. C. Green, and treasurer, Mr. J. R. Tomlinson, all of Portland.

* * *

Pittsburgh Jovian Luncheon.—About seventy-five members were in attendance at the weekly luncheon of the Jovian Order in Pittsburgh, Pa., last week. The letter of Mr. J. H. Collins to the recent annual Jovian congress in New York was read for the benefit of those who had been unable to attend the convention and was received with much enthusiasm.

* * *

Washington Section of Radio Engineers.—The Institute of Radio Engineers now numbers twenty-five members in Washington. At a recent meeting of the committee for the formation of a Washington Section it was decided to hold a meeting in that city on Dec. 3. Emil J. Simon, 81 New Street, New York, is secretary of the Institute of Radio Engineers.

* * *

Louisville Engineers' Club.—A reception and housewarming marked the recent opening of the new quarters of the Engineers and Architects' Club of Louisville, Ky. Club rooms have been fitted up on the fourteenth floor of the new Stark Building. Mr. G. Wilbur Hubley, chief engineer of the Louisville Gas & Electric Company, is a past-president of the club and also one of its directors.

* * *

Proposed Association of Electric Sign Manufacturers.—A meeting of electric sign manufacturers will be held in Chicago, Ill., on Dec. 1 at 10 a. m. in the La Salle Hotel for the purpose of organizing an association of electric manufacturers to promote electric advertising. Preliminary arrangement details are being looked after by Mr. H. C. Menefee, editor of *Signs of the Times*, Cincinnati, Ohio.

* * *

Meeting of the Radio Engineers.—Dr. Lee De Forest presented a paper on "The Audion—Detector and Amplifier" at a meeting of the Institute of Radio Engineers held at Columbia University, New York, on Nov. 5. He discussed the principles of the operation of this device, described its use as a sensitive detector for radio communication and its more recent adaptation as a practical amplifier of exceedingly minute pulsating currents. The paper was accompanied by demonstrations of the apparatus described by Dr. De Forest.

* * *

Formation of Richmond (Va.) Society of Engineers.—A number of the professional engineers of Richmond, Va., met Oct. 16 and took the first formal steps for the formation of a local engineering society which will draw its members from all branches of engineering in that city. The present membership numbers fifty-three and a larger enrolment is expected. The officers chosen for the year are: President, Mr. Arthur Scrivenor; vice-president, Mr. James Bolton; treasurer, Mr. P. Parsons Pilcher, and secretary, Mr. Edwin Wortham.

* * *

Exposition by the Lumber Manufacturers' Association.—The National Lumber Manufacturers' Association is planning a "forest products exposition," with the object of exploiting wood, wood products, methods of use, and wood as a general commodity. The exposition will open in the Coliseum, Chicago, April 30, 1914, and will close May 9. It will then be moved to the Grand Central Palace, New York, where it will be open from May 21 to May 30. Mr. George S. Wood, 1621 Otis Building, Chicago, Ill., is manager of the exposition.

* * *

Colorado Women's Co-Electric Club.—Early in the summer the wives, sisters and daughters of the members of the Colorado Electric Club of Denver organized "The Co-Electric Club" for the purpose of broadening sociability among the women relatives of local electrical men. The Co-Electric Club meets at some prominent Denver hotel on the second Thursday of each month, when luncheon is served followed by cards. So far three dances have been given by the women's club to entertain the members of the Colorado Electric Club. On Oct. 28 a "harvest home" dance was held. Refreshments and light lunch have been features of these entertainments. Each member of the Co-Electric Club pays dues amounting to $1 per year. Following is a list of the club's officers: President, Mrs. Benedict Shubart; vice-president, Mrs. W. A. Carter; recording secretary, Mrs. A. F. Traver; corresponding secretary, Mrs. W. A. Roper; treasurer, Mrs. R. A. Lewis; monitor, Mrs. E. W. Woodbury, and historian, Mrs. A. R. Cliff.

* * *

National Association of Corporation Schools.—The National Association of Corporation Schools has been organized following a recent conference at the plant of the National Cash Register Company in Dayton, Ohio. Its objects are to develop the efficiency of the individual employee, to increase general efficiency in industry and to cause established educational institutions to introduce courses relating to industry. The association is composed of representatives of corporations which conduct schools for employees. Its officers are as follows: President, Mr. Arthur Williams, New York Edison Company; first vice-president, Mr. E. St. Elmo Lewis, Burroughs Adding Machine Company; second vice-president, Dr. C. P. Steinmetz, General Electric Company; secretary, Mr. Lee Galloway, New York University; treasurer, Mr. E. J. Mehren, *Engineering Record*; assistant secretary-treasurer, Mr. F. C. Henderschott, New York Edison Company. The executive committee is composed of Messrs. A. F. Bardwell, Yale & Towne Manufacturing Company; J. W. L. Hale, Pennsylvania Railroad; M. W. Mix, Dodge Manufacturing Company; E. C. Wolf, Curtis Publishing Company; William D. Kelley, Consolidated Gas Company; C. R. Dooley, Westinghouse Electric & Manufacturing Company; L. L. Park, American Locomotive Company; J. E. Rogers, National Cash Register Company, and Mr. Henderschott.

The Electrically Operated Ship "Tynemount"

Great Lakes carrier employing Diesel-type engine prime movers and Mavor multi-frequency alternating-current drive

IN the field of naval architecture the electric propulsion and electric steering of ships are attracting an increasing measure of interest. Afloat as well as ashore the advantages of electric drive are still constantly unfolding, revealing economies and conveniences of operation unknown with the elementary forms of mechanical propulsion. On board ship electricity early found recognition as a safe means of lighting poorly ventilated quarters where fire is always a dread menace. Close thereafter followed the use of electric heating, so that to-day all the great ocean leviathans have their cabins equipped with resistor radiators.

But, aside from small boats propelled by battery power, electric drive was first suggested as a means for ship propulsion in order to couple the inherently high speed of the steam turbine with the stubbornly slow velocity at which the screw propeller has its highest efficiency. The advantages gained lie in greater flexibility of control and even the possibility of manipulation from the bridge. The Chicago fireboats with their turbine-driven direct-current generators and twin motor-driven screws are examples. These interesting vessels are in fact not only propelled but also steered through the busy Chicago River by their two motor-driven propellers. Alternating-current generators and motors have been used with success on the new electric-driven United States Navy collier *Jupiter*, described in these columns Aug. 3, 1912. On her sea trials this vessel recently made 14.78 knots per hour, exceeding her guarantee by nearly three-quarters of a knot.

General Features of the "Tynemount"

The following paragraphs are devoted to an account of the electric-driven ship *Tynemount*, recently completed in England and designed for operation on the waters of the Great Lakes of North America. Measuring 250 ft. in length and 42.5 ft. in beam, with a 19-ft. draft, she is one of the largest ships to be thus far fitted with electric drive. Her prime-mover equipment is of the Diesel internal-combustion type, the engines driving alternators which in turn operate the special Mavor 500-hp motor which drives the single propeller.

Built as a freighter, the *Tynemount* has one steel deck and three cargo holds with seven large hatches. Forecastle and navigating bridge are located forward, and the poop aft. The machinery is also accommodated aft, beneath the poop. Use can be made of the ship's double bottom for carrying an extra supply of fuel oil in addition to the contents of the two tanks on deck forward of the poop bulkhead.

Internal-Combustion Prime-Mover Set

The prime movers of the *Tynemount* installation consist of a pair of six-cylinder, high-speed, internal-combustion engines of the Diesel type, manufactured by Mirrlees, Bickerton & Day, Ltd. Each is capable of developing 300 brake-hp at 400 r.p.m. on the four-stroke cycle, the diameter of the cylinders being 12 in. and the stroke 13.5 in. The engines are totally inclosed, forced lubrication being employed throughout.

A substantial bedplate is provided, cast in two pieces which are bolted together and joined with the alternator bedplate at the flywheel end of the engine. The six cylinders are divided into two groups of three each, the vertical shaft which drives the cam shaft being placed between the two groups. The crank shaft is built in two pieces, the gear wheel which transmits the motion to the vertical shaft being bolted between the two flanges of the central coupling. These flanges are turned solid with the shafts.

The engines which are connected to the alternators by the usual couplings are placed on the forward end of the machinery space, on the port and starboard sides. A hand-lever barring gear working in an internal rack on the fly-

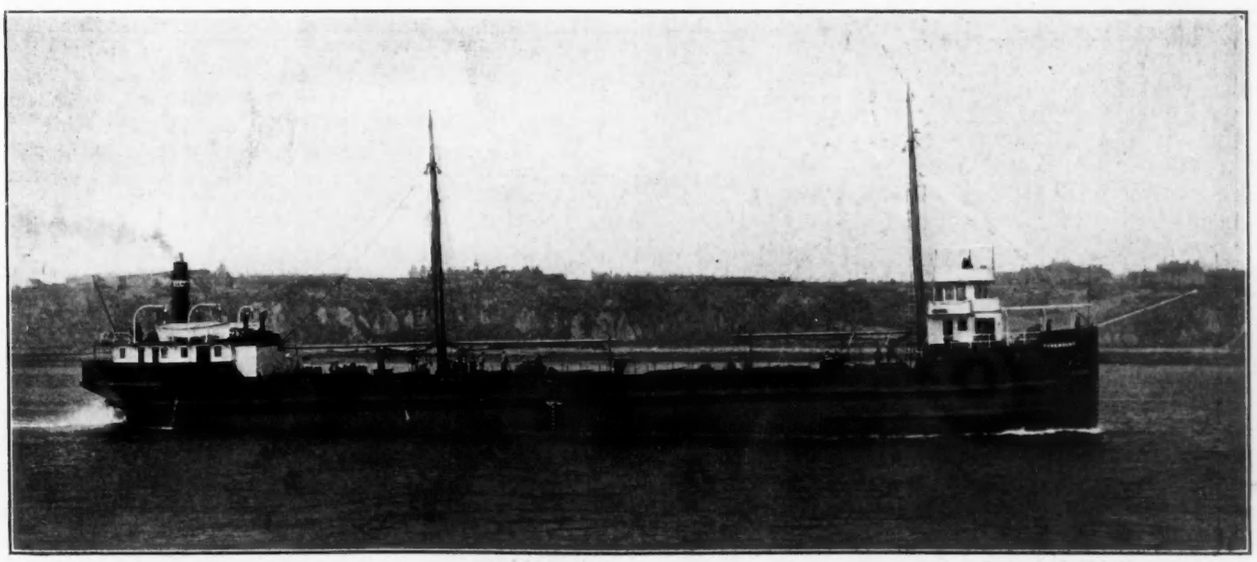


FIG. 1—THE ELECTRICALLY OPERATED SHIP "TYNEMOUNT"

wheel provides for turning the engine into the starting position when required. Starting is effected by compressed air, the three cylinders at the flywheel end being fitted with starting valves. Their operation is rendered easy by a system of bell-crank levers and coupling rods transmitting the motion from a control pillar on the engine-room floor near the air receivers. Means for stopping the engine and

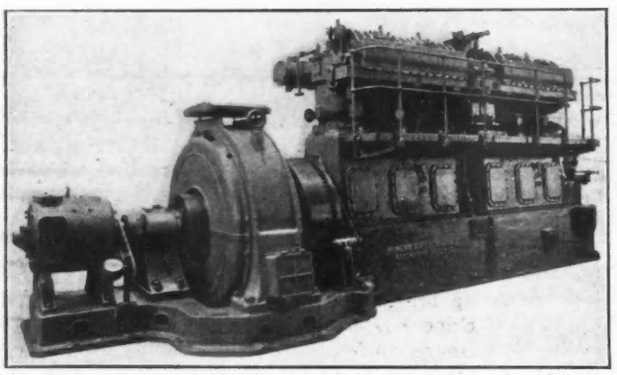


FIG. 2—COMBINED GENERATING SET

for controlling the amount of air delivered by the compressor are also provided on the same pillar. Near at hand also is the electric controller of the transmission system, the whole providing a compact and centralized arrangement for the operation of the propelling machinery.

At the rear of each engine is a three-stage air compressor, direct driven from a shaft extension which also drives the lubricating and circulating-water pumps.

The valves are situated in the cylinder covers and are operated by cams and levers. The fuel valves are of the ordinary needle type, and open upward, while the exhaust and air valves open downward. An important feature of the valve actuating levers is the provision of a hinged and bolted joint in each, which, by the undoing of one bolt, allows any lever to be folded back so that the work of withdrawing the valves is reduced to a minimum. All the valve seats are made separate from the cylinder covers and can be withdrawn bodily with the valves. Spare valves and seatings are carried, so that all grinding-in can be done on the bench at the engineer's convenience.

The pistons are of the trunk pattern and have separate

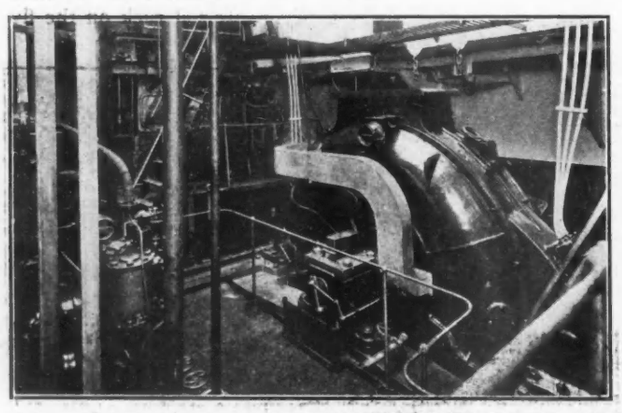


FIG. 3—REAR OF ENGINE ROOM, SHOWING PROPELLER MOTOR

heads. The top ends of the connecting rods are fitted with gun-metal bushes working on case-hardened piston pins.

The fuel pumps for delivering oil to the cylinders are situated on either side of the vertical shaft gear casing and are driven by eccentrics from the cam shaft. Each of these eccentrics operates a small crosshead to which are fitted the three plungers of each pump. Fuel oil is fed by gravity to the fuel-pump suction chamber from the "ready-use" tanks, which are situated on the forward bulkhead of the engine room. The amount of oil passing to the cylinders is determined by the governor, which is fitted on the upper portion of the vertical shaft. A system of coupling rods and levers connects the governor arm with a small spindle passing through the fuel-pump suction chamber. To this spindle tappets are fixed, which determine, according to the position of the governor, the length of time the fuel-pump suction valves remain off their seats. Until the suction valves are closed no oil is delivered to the fuel valves on the cylinder covers.

The two groups of cylinders composing each engine are carried by inclosed columns each cast in a single piece but provided with inspection doors of ample size. Access to the valves and valve gear is provided by grated patforms running the length of each engine.

The circulating water after passing through the engines goes to the exhaust pipes, which are also water-cooled. Thence it passes from each engine through a water-flow indicator into a branch fitting from which two pipes are led, one going to the discharge valve on the ship's side and the other to the suction side of the circulating pump.

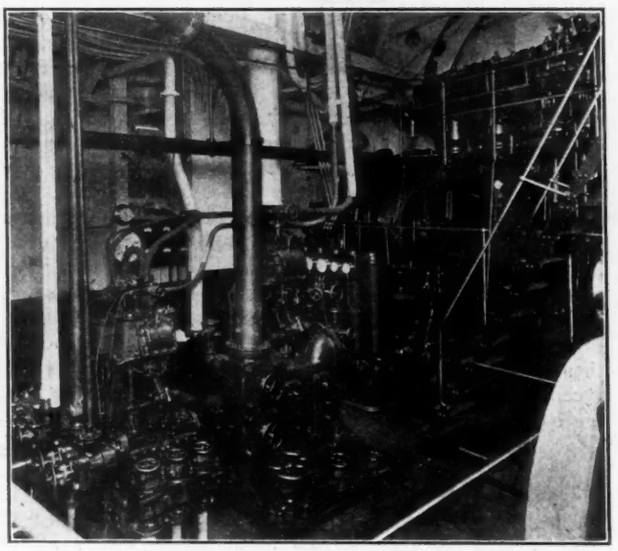


FIG. 4—ENGINE ROOM, SHOWING ONE GENERATOR SET

In this way when the ship is sailing in cold waters warm water can be mixed with the incoming water from the weed traps. When the ship is running in fresh water it will also be possible to pass the hot circulating water from one engine into the feed tank of the donkey boilers. When the engines have been stopped and are cooling off it has been arranged that the sanitary pumps may pass circulating water through them and thus lessen the chances of precipitation of salts or alkaline matter in the jackets.

Alternating-Current Apparatus

The electrical equipment consists of two Mavor & Coulson three-phase alternators, each direct-coupled to one of the Diesel engines. The alternators when running at full load at their normal speed of 400 r.p.m. generate a pressure of 500 volts and currents of 270 amp per phase. They are provided with six and eight poles respectively, making the frequency produced by one 20 cycles per second and that of the other 26.6 cycles per second.

An exciter is directly connected to each alternator and is capable of giving an exciting current of 30 amp for ordinary operation, which can be increased up to 50 amp while maneuvering.

The output from these two generating sets is led to a

500 brake-hp induction motor of special construction, built under the Mavor & Coulson patent. Its rotor is of the squirrel-cage type but the stator is provided with two different and entirely separate windings, one having 30 and the other 40 poles. When these two windings are supplied with current at 20 and 26.6 cycles respectively, they give the same synchronous speed of 80 r.p.m. The motor will then absorb the full power of both engines and drive the propeller to which it is directly coupled at a speed of 78 r.p.m. This propeller speed corresponds to the fastest speed of the vessel.

To obtain a slower speed the connections are changed so that the 20-cycle alternator supplies the forty-pole winding of the motor. The 26.6-cycle alternator can then be shut down, while the thirty-pole winding of the motor is also out of use. The synchronous speed of the motor with the propeller is now reduced to 60 r.p.m. Only one of the engines is now available, but as the speed of the ship is reduced to about three-quarters of its rate of travel, half of the total engine capacity is ample. In this way the great advantage is obtained of being able to shut down entirely that part of the plant which is not required at the low speed.

From the foregoing description it will be noted that the two alternators, when both at work, are connected to en-

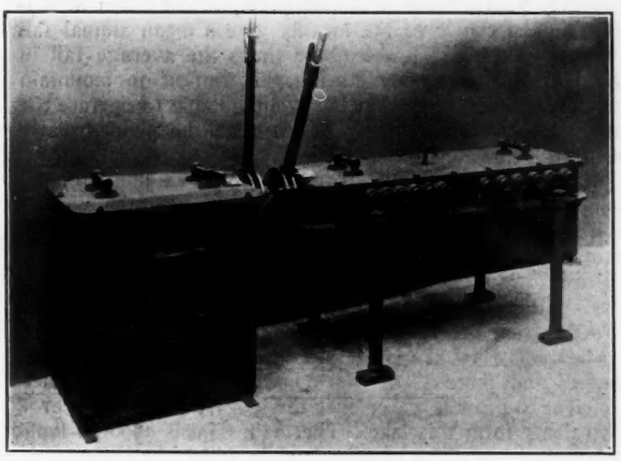


FIG. 5—SWITCH GEAR

tirely separate circuits and that they are therefore never run parallel. Obviously, the paralleling of two alternators, necessitating that they should be run up to speed and synchronized before being switched onto the load, is quite unsuitable for ship work; for this operation not only requires skill and care but would involve considerable delay in starting the propeller motor.

In the case of the *Tynemount*, the motor is readily reversed by interchanging the connections of two of the phases.

Switching Apparatus for Control

The switch gear which effects the necessary changes in connections is itself very simple, consisting of two parts. The main switch is of the railway-controller type having the five different positions, "full ahead," "half ahead," "stop," "half astern," "full astern." The second and smaller switch serves to introduce resistance into the shunt circuit of the exciter.

The contacts of both switches work under oil, but it is inadvisable that the contacts of the main switch should be required to break the large main current flowing to the motor. The two switches are, therefore, so interlocked that it is impossible to work the main switch except when all the resistance has been introduced into the exciter field coils. There is then practically no excitation and the whole system is "dead." With the resistance in the exciter field circuit, the main switch can be moved to any one of its four working positions, and when the main connections have been made for the new running position the shunt switch lever is pulled over so as to cut out the resistance and restore the excitation. Until the main switch is definitely on one set of contacts the shunt switch

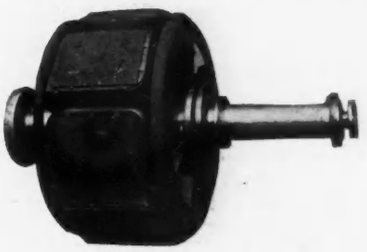


FIG. 6—ROTOR OF ALTERNATOR

is locked so that the excitation cannot be restored, thus eliminating possibility of burned contacts.

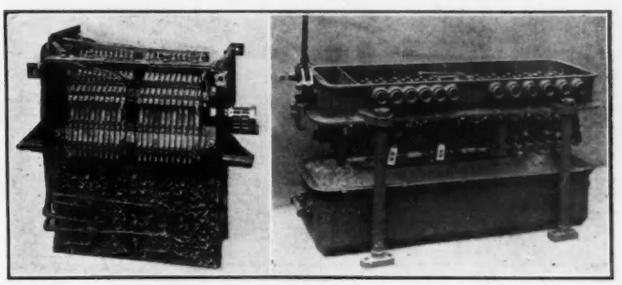
It is thus clear that the whole handling of the ship can be carried out by means of two levers which are so interlocked as to be practically fool-proof. In the case of the *Tynemount* these switches are installed in the engine room, but it is evident that by lengthening the connecting cables they could be placed on the navigating bridge.

The number of electrical instruments provided has been kept down to a minimum. There are one ammeter and one voltmeter for each alternator, and an ammeter and a voltmeter for each exciter. The handling of the switch gear is so simple that no necessity exists for multiplication of the measuring instruments.

Use of electrical drive enables the speed of the ship to be altered without altering the engine speed. It also permits a convenient gear ratio, enabling the engines and the propeller respectively to be run at their most efficient speeds, and also provides for the ready reversal of the propeller while the engines continue to run in their normal direction.

In addition to the above advantages, it is found that in many cases the electric system allows of a reduction in the machinery space and also in the bunker space required, thus increasing the cargo capacity of the vessel. As a subsidiary advantage it lends itself readily to distant control. In any case where advisable the switch gear can be put on the bridge and the control of the motor driving the propeller be put directly into the hands of the navigating officer.

The system of electric drive used is that designed by Mr.



FIGS. 7 AND 8—EXCITER SWITCH REMOVED FROM CASE AND MAIN SWITCH WITH COVER REMOVED AND OIL TANK LOWERED

Henry A. Mavor. The *Tynemount* was built by Swan, Hunter & Wigham Richardson, Ltd., of Wallsend, to the classification of the British Corporation B. S., and to the order of the Electric Marine Propulsion Company, Ltd., a corporation formed to develop the system associated with the name of Mr. Mavor.

100,000-Volt Transmission Into Bombay, India

Features of the Tata high-head development utilizing the 200-in. rainfall of the Western Ghats—Ultimate 66,000-kw system with cotton mills as principal load

CONSERVING the phenomenal precipitation of 200 in. per year which falls on the lofty slopes of India's Western Ghats, and conducting this unfailing supply through an almost sheer drop of 2000 ft. to the 66,000-kw power house on the plains below, the great Tata water-power development will shortly be supplying hydroelectric energy to the ancient Parsee city of Bombay. Transmission over the 43-mile distance will be accomplished at 100,000 volts, the lines being carried on modern steel structures—Bombay's latter-day "towers of silence"—to adapt the title of those grim mortuary buildings, strewn with carrion, which are found to the northward of Malabar Hill.

Among the commercial applications of this imported hydroelectric energy, electric drive of cotton mills will demand large blocks of power. Bombay has eighty-three cotton mills, with 3,000,000 spindles and 43,000 looms, which are now operated by isolated steam plants aggregating 100,000 hp in rating. The Indian coal used in these plants costs about $5 per ton. Already, however, some 10,000 hp in electric motors is installed in India's textile mills.

While the Tata development which is the subject of this article is by far the largest undertaking of its kind in the peninsular empire, India has not been slow in the utilization of her natural water-power resources. Hydroelectric schemes have already been carried out in Mysore, Kashmere and Afghanistan. Of these the first named, which is on the Cauvery River, is the most important. With a capacity of 13,000 hp it furnishes energy to the towns of Mysore and Gangalore, respectively 35 and 60 miles away, and to the Kolar gold fields at a distance of 92 miles. The transmission-line pressure is of 35,000 volts. This system has been in successful operation for several years and is now being brought up to 20,000-hp capacity.

System of Storage Lakes

The Western Ghats, India's famous coast range fronting on the Arabian Sea, rise precipitously in horizontal layers of trap rock to a height of 2000 ft. to 3000 ft. above ocean level. Rain falling to the west of this sharp edge runs down directly to the Arabian Sea, and it is on the collection and storage of the tremendous rainfall occurring annually during the southwest monsoon that the present water-power scheme is based.

Thirty years' records of this precipitation taken at stations in the center of the locality give a mean annual fall of nearly 200 in., or about five times the average fall in the United States. By storing this run-off in mountain lakes, a continuous supply is made available to operate the turbo-generators in the power plant on the plains, nearly 2000 ft. below.

The storage lakes and hydraulic works of the Tata development are near Lonawla, a hill station at the summit of the Bhor Ghat. The lakes have been formed by constructing masonry dams across the Lonawla, Walwhan and Shirawta valleys, as shown in the accompanying map. During the monsoon period, however, water will be used directly from the rainfall.

The Lonawla Lake is the storage basin provided for the "burst" and "breaks" of the monsoon, and has a capacity sufficient to provide water over the longest break on record. Two dams form this lake. The main dam is 3600 ft. long and 40 ft. high. The smaller dam, in which the sluices are

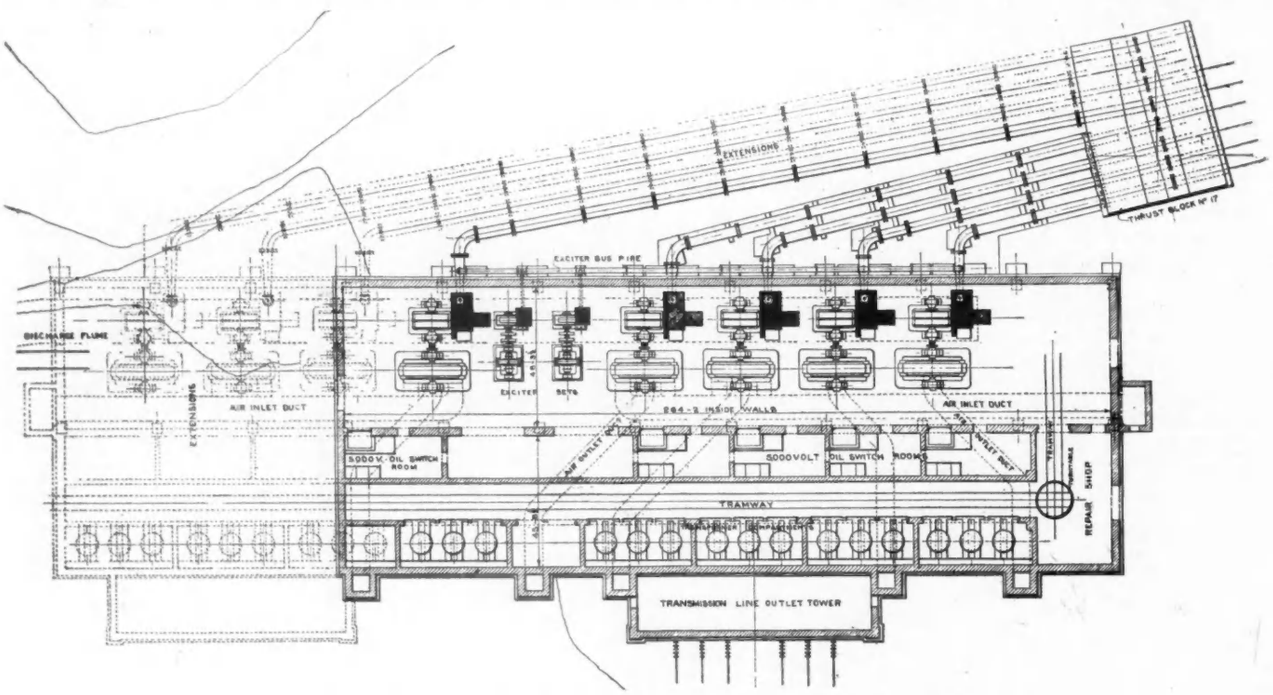


FIG. 1—PLAN OF HYDRAULIC AND ELECTRICAL EQUIPMENT, POWER STATION

located, measures 1900 ft. long and is 26 ft. above lowest level of valley across the headwaters of the Indreyani River. The area of this lake will be 986 acres, or 1.54 sq. miles, and the total capacity 466,000,000 cu. ft. in the 19-ft. range between outlet level and the full supply level at an elevation of 2051 ft.

For the rest of the year water will be drawn from the other two storage lakes. Malwhan Lake, near the village of that name, is formed by constructing a dam 4500 ft. long and 75 ft. high. This lake when full will have an area of 1535 acres, or 2.4 sq. miles, with a total capacity of 2,560,000,000 ft. between its outlet and full levels. Its full-supply level has an elevation of 2086 ft. above sea level. The dam will be provided with waste escapes and ample sluices of large dimensions, and the top will carry a footpath and a tramway with parapets on each side.

Shirawata Lake is the second storage basin, which is formed by constructing an 8000-ft. dam, 100 ft. high, across a valley to the north of Walwhan Valley. Its area when full will be 3174 acres, or 5 sq. miles, and its available capacity 7,102,000,000 cu. ft. The outlet will be at the same elevation as the full-supply level of Walwhan Lake, with which it will be connected by a tunnel 5000 ft. long through the trap-rock of the hills.

FOUR-MILE MASONRY DUCT

From Walwhan Lake water is led to the forebay at the edge of the Ghats by a masonry duct, 4 miles in length. The difficult country encountered here has required the construction of numerous aqueducts, tunnels, cuttings and embankments, besides crossing en route the Bombay Poona road and the G. I. P. Railway. The duct has a total capacity of 120,000 hp and terminates at the forebay,

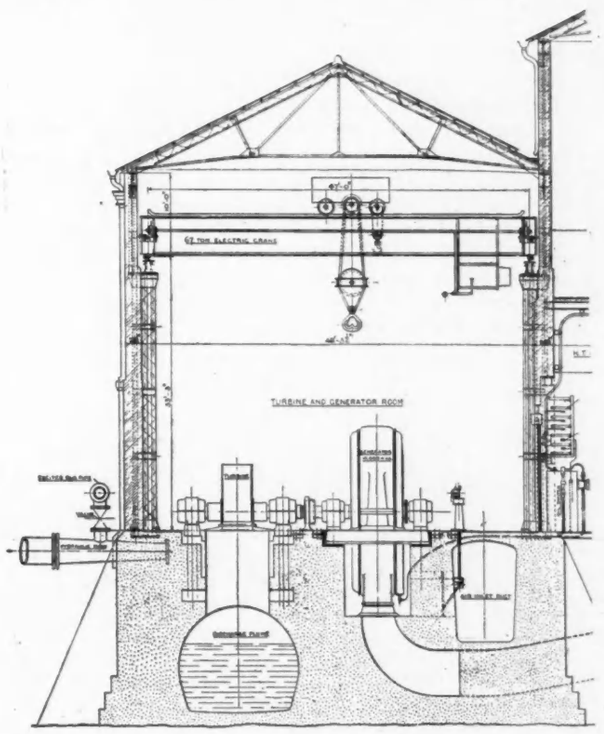


FIG. 2—SECTIONAL ELEVATION OF GENERATING STATION AT KHOPOLI

which is formed by masonry walls in a small valley at the edge of the cliff near Khandalla.

The duct from Lonawla Lake is 2150 ft. long and joins the Walwhan duct at a point 2.45 miles from the Walwhan dam.

Messrs. Pauling & Company, of London, are the contractors for the dams, ducts and forebay.

STEEL PIPE LINE TO POWER HOUSE

From the forebay the pipe line, one of the largest ever built, conveys the water down the cliffs and steep slopes to the power house on the plains below, near Khopoli. This conduit has been designed in two sections, with two upper and eight lower pipe lines.

The initial installation (which constitutes half the

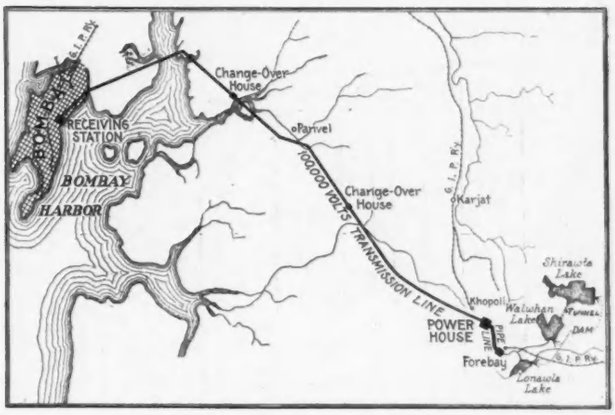


FIG. 3—MAP OF STORAGE LAKE AND TRANSMISSION LINE OF TATA DEVELOPMENT

scheme) will comprise one upper pipe line, a distributing pipe and four lower pipes, the total route length being about 13,000 ft., divided into 8200 ft. of upper pipe line and 4800 ft. of lower pipe line. The first section of the upper pipe line, starting at the forebay, is of riveted steel tube, 82 in. in internal diameter and 0.375 in. thick, while the second section is 77 in. in internal diameter and 0.375 in. to 0.8125 in. thick. The third section, ending at the distributing pipe, is of lap-welded steel tube 72 in. in diameter and 0.6875 in. to 0.8125 in. thick.

The distributing pipe consists of a bend and a straight pipe section, 72 in. in internal diameter and 0.9375 in. thick. Its length is about 46 ft. and it opens into five 42-in. branches.

The first section of the lower pipe line, starting from the distributing pipe, is of lap-welded steel tube 42 in. in internal diameter and 0.5 in. to 0.6875 in. thick. The second section, which sustained the greatest pressure of any part of the the pipe line, is of lap-welded steel tube 38 in. in internal diameter and 0.875 in. to 1.25 in. thick.

Both the riveted and welded pipes are made from open-hearth Siemens-Martin steel plates. The riveted type have tensile strengths between the limits of 28 tons and 32 tons per sq. in. and an elongation of 20 per cent. The lap-welded pipes have tensile strengths of 24 tons to 28 tons per sq. in. and an elongation of 26 per cent. The strength of the welded joints is estimated to be at least 90 per cent of that of the solid plates. The factor of safety of both the upper and lower pipe lines, calculated on minimum tensile strengths and maximum static heads, is not less than 4.5.

The whole of the pipe line is laid above ground, provision being made for variations of temperature from 50 Fahr. to 127 Fahr., by means of expansion joints. At these fixed points angle-iron rings are riveted to the pipes and anchored securely to the masonry by means of iron bars, the concrete thrust blocks being strengthened by reinforcement with I-beams.

The waste-weir elevation at the forebay is 2032 ft., and the power-house floor is 307 ft. above mean sea level, giving a static head of 1727 ft. with a corresponding pipe pressure of 743 lb. per sq. in. With four turbines developing 11,000 hp each, the total loss of head due to friction is approximately 66 ft. The pipe line will be capable of supplying water simultaneously to four 11,000-hp turbines

and two 850-hp turbines, with provision for connecting an additional 11,000-hp turbine to the upper pipe line.

Messrs. Escher, Wyss & Company, of Zurich, are the contractors for the pipe lines.

The Power House at Khopoli

The Tata development has been designed for the ultimate installation of eight main units of 11,000 hp each,

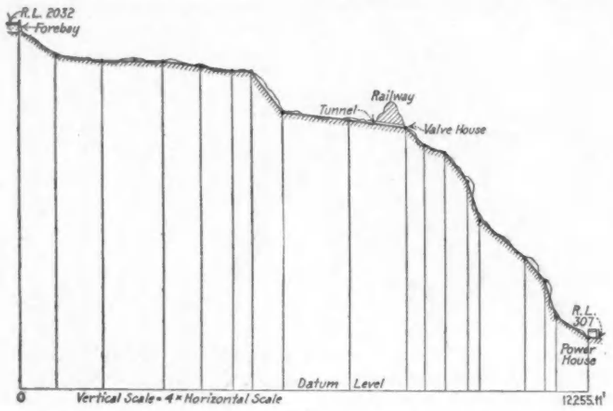


FIG. 4—PROFILE OF HIGH-PRESSURE PIPE LINE

two exciter units of 850 hp each, eight banks of step-up transformers of 10,000 kva each, and the necessary switch gear and auxiliary apparatus.

The power-house building, although capable of extension as required, provides at present for five main and two exciter sets, with five transformer banks and switch gear. The equipment now being installed includes, however, only four main units. The generator room, 254 ft. by 48 ft. in dimensions, is spanned by a 67-ton electric traveling crane.

Each waterwheel set comprises an 11,000-hp Escher-Wyss horizontal impulse turbine running at 300 r.p.m., coupled to a Siemens 8000-kw, 5000-volt, 50-cycle, three-phase generator capable of 20 per cent overload for ten hours. There are two exciter units, each comprising Escher-Wyss 860-hp turbines, running at 600 r.p.m. and coupled to 600-kw, 250-volt, shunt-wound, direct-current Siemens generators.

Four banks of step-up transformers will be installed, each consisting of three 3333-kva oil-insulated, water-cooled, 5250/100,000-volt, 50-cycle, single-phase units, connected delta to delta and having 20 per cent overload capacity for ten hours.

The turbine wheels have cast-steel disks with cast-steel buckets. The shafts are of Siemens-Martin steel with two-ring lubricating bearings equipped for water cooling. The cast-steel nozzles are of the deflecting type. The governors, which operate by oil pressure, are fitted with hydraulic automatic servo-motor precision gearing which is guaranteed to limit the turbine speed variation to 2.5 per cent, 5 per cent and 12 per cent respectively when one-quarter, half or full load is suddenly thrown off.

Each deflecting nozzle is fitted in its inlet pipe by means of two bearings made water-tight on both sides by leather collars. The servo-motor which actuates the nozzle consists of a casing with differential piston (of which the lower small piston is under constant water pressure and the upper large piston is under variable water pressure) and a dash-pot connecting the deflecting nozzle and automatic speed governor, the needle only being rigidly connected to the governor.

In the event of a sudden closing movement, the servo-motor of the governor lifts both the lever of the main regulating shaft and also the dashpot. The discharge valve located immediately below the latter then opens a slot through which the water above the piston can escape. The piston of the servo-motor and the entire deflecting nozzle are thus lifted so that the jet is diverted from the runner wheel, the levers being so arranged that during this operation there is no movement of the needle to close the nozzle, thus guarding against an increase of pressure in the pipe line. The nozzle then begins to return to its normal position, the needle at the same time decreasing and closing the jet outlet. This movement follows automatically by the action of the dash-pot, the piston sinking slowly and closing the discharge valve situated below, while pressure water enters the large cylinders of the servo-motor. The latter's piston is thus forced downward, and the deflecting nozzle returns to its normal position. With a slow closing movement of the regulator the nozzle is not deflected, owing to the slow movements of the dash-pot piston, the needle being slowly operated directly from the regulator. With an opening movement of the regulator the nozzle is simply opened as in the case where no deflecting mechanism is used.

The thrust in the inlet bend caused by the deflection of the water is taken up by a thrust-plate fitted on the end cover of the outside bearing, the bearings being connected by four strong rods. The exciter turbines are tangential wheels with separately fastened cast-steel buckets and governors similar to those on the main units. The guaranteed full-load efficiencies are 82 per cent for the main units and 79 per cent for the exciter turbines.

Electrical Equipment in Generating Station

The main generators have continuous full-load rating of 8000 kw, developing 5000 volts between phases. Their regulation at unity power-factor is 9 per cent and at 80 per cent power-factor 22 per cent. The guaranteed full load efficiency at 80 per cent power factor is 94.3 per cent. The Siemens Brothers Dynamo Works are the contractors for the generating plant and exciters, with Escher, Wyss & Company, of Zurich, as sub-contractors for the main and auxiliary turbines.

Each step-up transformer bank consists of three General Electric single-phase, oil-immersed, water-cooled, 5000-5250/100,000-volt, 50-cycle transformers designed for a full-load output of 3333 kva at 80 per cent power-factor. The water circulation required at full load is 950 gal. per hour. The guaranteed regulation at full load with unity power-factor is 0.8 per cent and at 80 per cent power-factor 4.6 per cent. The full-load efficiency at 80 per cent power-factor is 98.1 per cent.

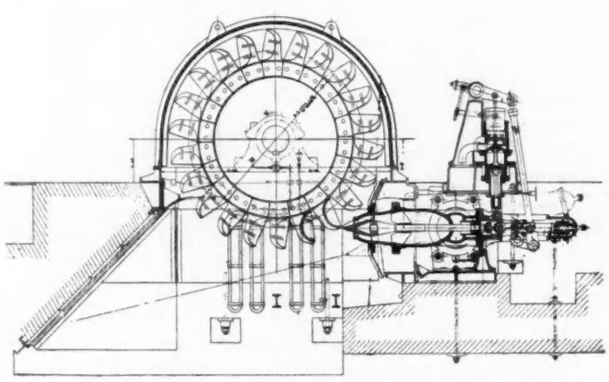


FIG. 5—SECTION THROUGH 11,000-HP TURBINE WHEEL

These transformers are of the shell type, having flat primary and secondary coils placed vertically and surrounded by laminated sheet-steel cores. The high-tension bushings are of the compound-filled pattern.

Following are the dimensions and weights of each transformer: Height to top of high-tension lead, 16 ft.; to cover, 13 ft.; diameter of tank, 8 ft.; weight, assembled and filled with oil, 24 tons; weight of core and coils, 11 tons.

The amount of oil required for filling is 2300 gal., equivalent to 8 tons.

All switch gear in the Khopoli power house is electrically operated from a benchboard on the gallery overlooking the generator room at a point which will eventually be the center of the building. In addition an auxiliary switchboard for station service, exciter control, generator field-switch panels and signal apparatus are located on the generator-room floor.

The six-panel benchboard, built of blue Vermont marble, controls the four main generators with their step-up transformer banks, two exciters and the two outgoing 100,000-volt, 36,000-kva, three-phase lines. The exciter-switch panels carry single-pole solenoid-operated circuit-breakers and the generator-field switch panels double-pole solenoid-operated field switches. The generator-field series rheostats, the turbine governors and the air-duct shutters are all operated by 220-volt motors. The air-duct shutters are interlocked with the generator-field switches so that when the fields are energized the shutters will be open. The low-tension or 5000-volt buses are of copper-bar section.

In the transformer high-tension circuits to the outgoing lines automatic oil-break switches are employed, each circuit having three single-pole, single-throw solenoid-operated switches in iron tanks. Each of these switches has a rupturing capacity of 50,000 kva, automatic protection being afforded by means of series inverse-time-limit overload relays.

The 100,000-volt oil-switch room is located on the floor above the transformer compartments, all of this high-tension apparatus being connected up with copper tubing carried on post insulators. The layout of the wiring has been arranged for a spacing of 5 ft. between phases and a minimum striking distance of 3 ft. to ground. The lightning-arrester equipment is of the indoor type, the horn-gaps and cells being located in the transmission-line exit tower. Each outgoing line is protected with choke coils and 100,000-volt, aluminum-cell arresters, complete with horn gaps, disconnecting switches, discharge alarms and discharge recorders.

The General Electric Company of America is the contractor for the transformer and switch-gear equipment installed in both the generating plant and the receiving substation.

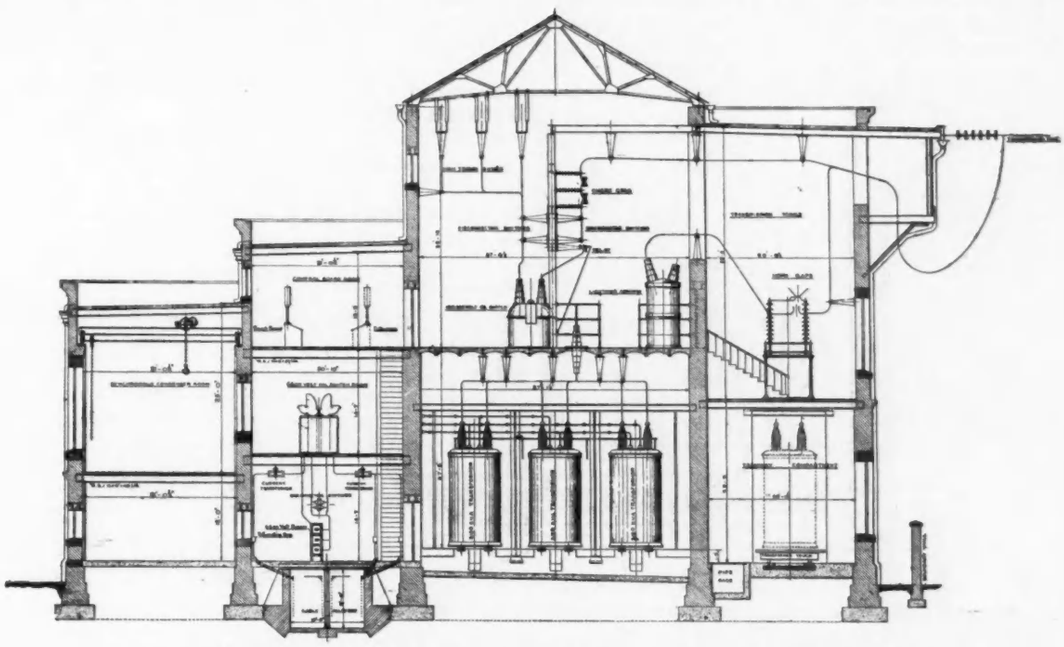


FIG. 6—ARRANGEMENT OF HIGH-TENSION EQUIPMENT IN BOMBAY RECEIVING SUBSTATION

100,000-VOLT TRANSMISSION LINE

The route of the transmission line from Khopoli to Bombay is shown on the map herewith. It starts at the power house at Khopoli and terminates at the receiving station on the island of Bombay, with a total length of 43 miles. En route the line crosses two tidal creeks (one 10,000 ft. wide and 42 ft. deep at high tide), a railway and several roadways. Ultimately there will be four transmission lines normally working in parallel, and carried on two lines of towers. Two "change-over" stations with disconnecting switches are provided, by which it is possible to divide the line into three sections for cutting out or interconnecting different sections as conditions demand. The present contract covers, however, only two transmission circuits carried in one set of towers.

The copper conductors used have a section of 0.095 sq. in. They are installed with a spacing of 10 ft. 6 in. between wires, and are carried on six-unit suspension-type insulators. The towers are of Siemens-Martin steel with a tensile strength of 28 tons to 32 tons per sq. in. They are built in two sections, a superstructure and a base, riveted together at the site. Three kinds are required—suspension towers, anchor towers and special structures for the creek crossings. In all, about 500 towers are used in the line. The suspension towers have been designed for the condition of any two conductors breaking, and the anchor towers for all the conductors breaking on one side. Wind pressures of 25 lb. per square foot were taken in making the computations.

The standard towers are 66 ft. high and are spaced 500 ft. apart. The special crossing towers are spaced 1175 ft. apart and have a height of 160 ft. to comply with the government requirements that no part of the transmission line shall come within 80 ft. of the water at high tide. The sag of the wires is regulated to give a strain, due to their weight, of not more than one-fourth of the breaking load at 50 deg. Fahr. and the minimum wind pressure.

Each insulator unit is designed to withstand a direct mechanical strain of 3 tons and when tested under conditions of service must pass a test of 1.5 tons strain. Electrically each unit must also undergo a pressure test of 70,000 volts dry, and each assembled insulator 300,000 volts dry and 200,000 volts wet, without flashing over or showing defects.

The contractors for the towers and insulators are Messrs. Bullers, Ltd., of London, and for the copper conductors, Felten & Guilleaume.

Receiving Substation at Bombay

The receiving substation is located at Sewree on the island of Bombay, about two miles from the docks. It has been designed for an ultimate capacity of 74,880 kva in eight step-down three-phase transformer banks of 9360 kva each.

The present building provides for five such transformer groups, four of which are now being installed. Each bank consists of three single-phase, oil-immersed, water-cooled, 85,800/6600-volt transformers, rated at 3120 kva. The windings are connected delta to delta and the units are designed for continuous full-load operation at a temperature rise not exceeding 58 Fahr. above cooling water at 87 Fahr.

The switch-gear equipment is generally similar in design, arrangement and layout to that in the power house already described, and consists of remote-controlled electrically operated oil switches and other apparatus actuated from a centrally located benchboard. This benchboard, which is capable of extension as required, is of blue Vermont marble and contains twenty-three panels for controlling and operating the two incoming lines, the four three-phase transformer banks, two synchronous condenser sets, thirty-two 6600-volt feeder circuits and the station service transformers. The equipment is complete with the necessary instruments, control switches, indicating lamps, mimic bus-bars and relays.

The high-tension buses are formed of copper tubing carried on post-type insulators. All low-tension buses are of bar copper. Solenoid-operated oil switches are employed to connect the incoming lines and the high-tension side of transformer circuits. Motor-operated switches are used for making the low-tension connections. The high-tension switches are of the single-pole, single-throw type, inclosed in iron tanks. The low-tension switches are triple-pole, single-throw units mounted in oil vessels inclosed in separate-cell compartments.

These oil switches provide automatic protection. Inverse-time-limit overload series relays control the solenoid switches in the incoming-line circuits, and inverse-time-limit overload and instantaneous overload relays govern the operation of the motor-operated switches in the low-tension sides of the transformers and the feeder circuits. These relays are mounted on the back of benchboard panels and are energized from the secondary sides of current transformers. The secondary relays of the transformer circuits are arranged to trip both the solenoid and motor-operated oil-switches.

The auxiliary switchboard is also of blue Vermont marble and controls the 120-kva, 6600/220-volt station-service transformer bank. The station operating battery has a capacity of 60 amp for eight hours and furnishes 220-volt energy for the remote-controlled switches.

The low-tension bus system is arranged in compartments on the ground floor, the oil switches being located on a floor overhead and connected through blade switches and current transformers to the buses and to the cable distribution system by cables run on racks in a special alleyway. The low-tension sides of the transformer circuits are connected to the oil switches by varnished-cambric insulated, fireproof-taped cables.

Each incoming line is protected with choke coils and aluminum-cell lightning-arrester equipment. A ground bus runs the length of the station.

Motor Equipment in Mills

It was in 1906 that Messrs. Tata, on behalf of the syndicate, first applied for power to carry through the present undertaking. The project was opposed, however, by the Bombay Lighting & Tramway Company, which already held a franchise for the supply of energy in Bombay. Finally, in 1907 after a lengthy inquiry the Indian government granted a license giving the Tata company the privilege of supplying hydroelectric energy within the city limits to customers whose consumption exceeded 500,000 kw-hr. per annum.

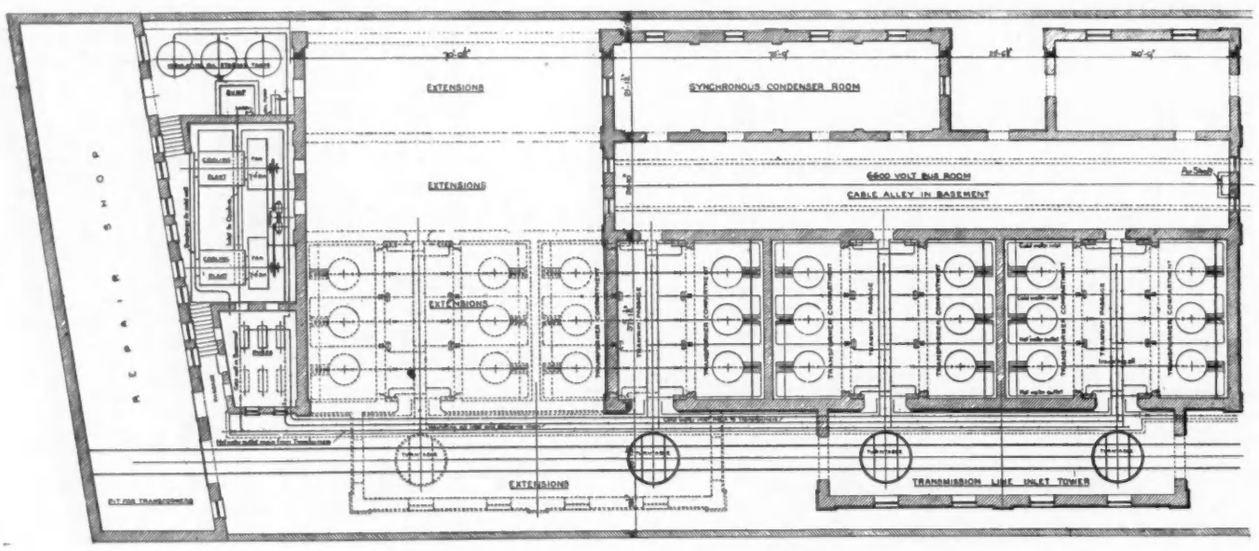


FIG. 7—GROUND PLAN OF RECEIVING SUBSTATION AT SEWREE, ISLAND OF BOMBAY

In 1911 the new company invited applications from mill owners and the general public, and within two months the whole of the available power provided for in the first section of the development had been contracted for by twenty-six cotton mills and two flour mills. A total of thirty-four mills have now contracted for hydroelectric energy from the Tata system.

The terms of these ten-year agreements between the power company and the mill owners cover the supply of energy for purposes of motor drive at 0.55 anna (about 1.65 cents) per kw-hr. in the case of mills where the electric installation is provided by the power company, and at 0.50 anna (1.5 cents) per kw-hr. in the case of mills furnishing their own motors and equipment, the company providing and maintaining the mill transformers. Energy for lighting will be supplied at 1.25 anna (3.75 cents) per kw-

hr., such consumption being separately metered and being also limited in quantity to 20 per cent of the energy supplied for motor drive.

The question of the best system of motor drive to meet the requirements of the Bombay industry was another problem which has been carefully investigated, many textile mills having been visited and the systems in use studied. After careful consideration the plan of group drive was recommended, using direct-coupled motors running at 290 and 365 r.p.m. These motors are of the 50-cycle, three-phase, slip-ring type and are wound for 2000 volts in sizes ranging from 50 hp to 500 hp. In special cases where the starting conditions admit squirrel-cage motors are employed in the smaller sizes. In some mills 500-volt motors will also be used.

The motors are designed to give full-load rating continuously at a temperature rise of 70 Fahr. in air at 100 Fahr., and also 50 per cent overload for periods of half an hour without injury. The motors at 290 r.p.m. have full-load efficiencies and power-factors ranging from 87 per cent and 74 per cent, respectively, for 50-hp motors to 92 per cent and 82 per cent for 500-hp machines. The motors at 365 r.p.m. have efficiencies and power-factors ranging from 86 per cent and 75 per cent for 50-hp motors to 92 per cent and 84 per cent for 500-hp sizes.

The three-phase feeder distribution system from the receiving substation to the mills is designed to operate at 6600 volts with ungrounded neutral, the cables being of the three-conductor, paper-insulated, lead-sheathed type. They are installed on the "solid" system, being embedded in bitumen in clay conduits.

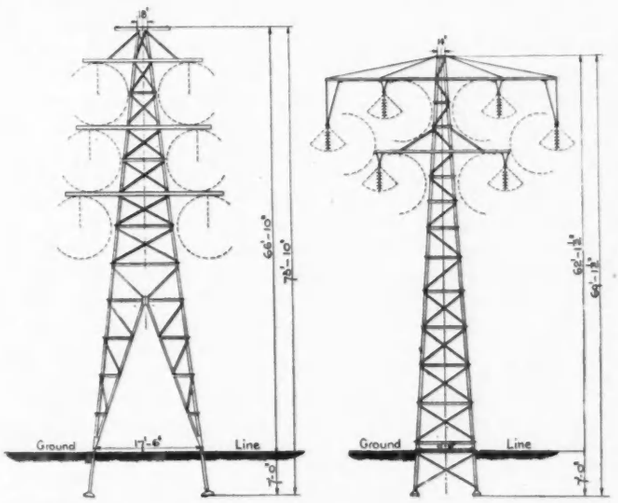


FIG. 8—ANCHOR AND INTERMEDIATE TOWERS, 100,000-VOLT LINE

SYSTEM OF RING FEEDERS FOR EMERGENCY USE

For distribution purposes the mills are divided into groups, each group having a feeder to each mill besides a ring feeder for all the mills of the group, for use in case of emergency.

Three-phase, oil-insulated, air-cooled, core-type transformers are used for stepping down from the 6600-volt supply to 2200 volts and 550 volts. The transformers are star-connected on both sides and are furnished in four standard sizes, 500, 600, 700 and 900 kva. They are designed to have a full-load efficiency of 98 per cent at 80 per cent power-factor, and a regulation of 2.5 per cent.

The standard customers' substation switch-gear equipment includes the high-tension buses to which the feeder circuits and high-tension side of transformer circuits are connected through disconnect links, and the low-tension buses with their disconnect links, current and potential transformers, wattmeters, etc. The motor circuits are run from the low-tension buses in paper-insulated, lead-sheathed cable to the switch pillars, and in single-conductor cable from the pillars to the motors. These switch pillars are of the ironclad interlocking design, each fitted with a triple-pole automatic oil-break switch with overload and no-voltage release, ammeter, potential transformer and isolating plug box. The interlocking design prevents accidental contact with live parts as the switch lever has to be in the "off" position before the pillar can be dismantled for overhauling.

The Callenders Cable & Construction Company, Ltd., is the contractor for the feeder system complete, the power-house and receiving substation connecting cables and the cables for wiring the mill equipments.

The British Westinghouse Electric & Manufacturing Company is the contractor for the mill equipments. The present order represents probably the largest mill-electrification contract ever placed, since it comprises sixty-four transformers aggregating 40,400 kva and 205 motors aggregating 36,150 brake-hp. An interesting feature of the motor equipment is that with one design of motor both single and double drive has been provided for. Sixty-four of the motors are arranged for inserting in the mill shafting and driving from both ends.

ADMINISTRATION AND ENGINEERING

Credit for bringing into existence the development above described is ascribed to the foresight and energy of the late Mr. J. N. Tata and his sons, Sir Dorabji J. Tata and Mr. Ratan J. Tata. The elder Tata was first convinced of the practicability of utilizing the run-off from the Western Ghats for generating electrical energy as far back as June, 1899. Encouraged by the Indian and Bombay governments, with the aid of the late Mr. D. Costling, of Bombay, he continued his investigations down to 1905. In that year Messrs. Tata, Sons & Company sought the advice of Alfred Dickinson & Company, consulting engineers, of London and Birmingham, who were afterward appointed consulting and constructing engineers for the entire scheme. This firm has had the able assistance of Mr. R. B. Joyner in carrying out the hydraulic work, and of Dr. John Mannheim, Mr. H. P. Gibbs and Mr. E. S. Wollard Moore on the electrical section of the installation.

Company Defrays Cost of Employees' Schooling

Any employee of the Edison Electric Illuminating Company of Brooklyn may select any course at any school or college in New York City which will be of assistance in his or her work with the company and have the tuition fee, subject to approval of the company's scholarship committee, paid in advance by the company, the amount being deducted in weekly instalments sufficient to pay for the course at its completion. If at the end of the term the employee passes the examinations with a grade of 66 per cent or better, the amount deducted from the salary list will then be returned to the employee, the company itself defraying the cost of instruction. If, however, the grade received falls below 66 per cent, no refund will be made. Where an employee severs his connection with the company during the school year the amount paid for tuition, less the sum already deducted, will be taken from his salary. Exception is of course made in the case of employees required to take up unforeseen duties, owing to transfers within the company.

Last year 136 employees, male and female, signified their intention of taking courses of instruction under the conditions above outlined. Of this number 113 actually started, and fifty-one of these students completed their courses successfully.

Swiss and Italian Transmission-Line Construction

By Dr. Louis Bell

The first sight of the transmission lines in Switzerland causes a person familiar with American practice to take notice immediately because they violate all our holiest traditions. Wooden poles are used almost exclusively save for an occasional line with lattice steel poles, generally square and rather slender.

The wooden poles are at first glance a shock, but when you think it solemnly over you revise your hasty conclusions and see what really clever engineering they represent considering all the circumstances. The typical transmission line is of surprisingly slender and beautifully straight poles seldom over 10 m out of ground and often hardly more than 9 m. They are seldom cut pyramidal at the top but are roofed with neat sheet-iron stampings. The normal spacing is 35 m to 40 m only, and the poles seem hardly more than half the weight of our own and taper notably less. Cross-arms are a rarity. The ordinary scheme is to use three hook-shaped steel supports passing through the pole as bolts and carrying small porcelain insulators. Two such hooks are on one side of the pole and one on the other, forming an equilateral triangle much smaller than we would commonly use. The pole is not weakened by cutting gains, and the top is left free for the cap.

The poles are quite generally of pine, but treated by impregnation, as ours seldom are, and their life is reported as good, quite up to our own untreated cedar or chestnut poles. The philosophy of this construction is interesting. In that territory poles of the sort described are cheaper than with us and labor is also much cheaper. Hence the Swiss can afford to use light poles spaced rather closely, when our own cost of poles and setting demands, for economy, fewer and hence stouter poles and wider spacing. And with the lighter construction the strains on the insulators are less and the supports may be correspondingly lighter.

Incidentally they do not seem to fear lightning as we do. I have yet to see a ground wire installed, although there are plenty of simple horn arresters, usually mounted on the pole tops, to bear witness that thunderstorms are not forgotten. I wonder whether our high poles and great steel towers are not really considerably more exposed than these and whether they do not hence require greater and far more costly precautions. The difference in practice is really astounding at first sight. Moreover, for the same voltage the insulators in Switzerland are uniformly much smaller than ours, yet the net results seem to be good. One large system with a transmission length of nearly 100 miles had a record last year of only seven interruptions of service, totaling a few minutes over an hour. Comparing this with some American lines I could mention, it would seem that we have not learned everything about transmission, though I am bound to say that our climate is worse to contend with.

Swiss engineers have no use for the beautiful light steel A-poles common in northern Italy; wood is cheaper. At angles in the lines there is excellent bracing by auxiliary poles, and at railway crossings strong steel poles are in quite general use, this practice being as a rule obligatory. Voltages range on the whole lower than with us. There is one German 100,000-volt line, but even 60,000 volts is a rare pressure, most of the lines being of only moderate length. Our own very long lines over troublesome country have produced a special type of construction, very admirable for its purpose, but copied, I think, too often, in cases where it is really quite unnecessary and a much simpler and cheaper line would serve the purpose just as well with an equally high factor of safety.

Along the route from Lake Como to Milan, Italy, where transmission lines are very much in evidence, there is a transition from the Swiss type of construction with wooden poles to the Italian with light steel poles, as befits a country where timber is scarce. A few Italian lines are wooden, in the timber country, but on the plains steel prevails. The poles are of various types, A-poles, slender quadrilateral lattice poles and tubular poles, none of them high, mostly from 10 m to 12 m, and usually spaced from 40 m to 50 m, with insulators of porcelain that always seem small compared with ours for similar voltage. Sometimes there are two circuits on one pole line, but more generally only one. In Switzerland transmission poles bear commonly a bright red band; in Italy the white placard with a skull and crossbones is a common symbol, and many lines have a circle of downward pointing prongs to discourage climbing. Grounded wires above the circuits are conspicuous by their absence, and simple horn arresters are frequent.

The English Tramway and Motor Bus

From the railway point of view the motor-bus situation in England is getting to be a serious matter, and it is therefore particularly interesting to note the attitude taken by the English railway managers. An elaborate scheme for making England a network of motor-bus routes has already been put forth and serious work is being done to make it a reality. In viewing the situation one must realize first that in and about London the motor bus is an enormously important element in the transportation system at the present time. It is reasonably fast, reasonably commodious and covers a wide area of activity. Motor buses may be found running far out into the suburbs, nearly always loaded with passengers and doing admirable service in the general handling of traffic. Whether the "tube" receipts actually show the effect of the bus traffic in any noticeable degree is dubious since London is growing at such a rate that increase in any transportation facilities merely decreases the congestion a little. Small grades and good roads, of course, help the situation immensely about London, but there is no doubt that the motor buses pay reasonably well and are of great value to the public. London would be in a bad way if the motor bus were to drop out of sight.

The railway managers are obviously somewhat alarmed over the situation, for the motor bus makes no such contribution in the way of taxes and upkeep of roadbed as does the railway. This freebooting feature of the motor-bus traffic would be specially noticeable if a comprehensive scheme extending over a large part of the country were carried out. Local railways would then be put into sharp competition with buses having no local allegiance or responsibilities, and the result might be serious. In some instances local authorities who have the right to regulate traffic have interposed to prevent this piratical competition. Since it is a fact that the motor bus with its great weight and fairly considerable speed tears up roadbed at a very serious rate, one is inclined to the opinion that local authorities may very well lay the restraining hand on the new vehicle until such time as in return for its passenger-carrying rights it makes some adequate contribution to the upkeep of the roads on which its activities are exercised.

At the recent convention of the Tramways and Light Railways Association all sorts of opinions came to the front, but they may be best typified by taking the extremes. One railway manager took the ultra-conservative view and tried to build up a case for the probable failure of the motor bus from the standpoint of permanent financial returns. No one, however, who has seen the motor buses loaded with paying passengers following their routes through the streets of London can doubt for a moment that the motor bus has come to stay and has excellent possibilities of returns.

The running expense of the motor bus was stated by the London company last year at a little less than 20 cents per

mile. On a route with scant traffic this might mean failure, but for metropolitan service the case is quite otherwise. At all events the motor bus is young in the game and will undoubtedly be improved in economy. At present in the London service it gets only some 7.5 miles per gallon of gasoline, a figure which may not seem excessively low to those who are operating big "sixes" in this country, but which from the English viewpoint is scandalous. When one remembers that the English automobile makers specialize on high economy on account of the cost of gasoline and that one can buy light touring cars guaranteed to travel 30 miles per gallon, it does not seem unreasonable to expect that the gasoline consumption of the motor bus may be reduced.

The strongest point of the motor bus is its traffic load-factor, because a fleet—if one may use the word—of motor buses can be adjusted to fit the traffic over any one route, and buses not needed there can be immediately shifted into service wherever traffic promises. In fact, the underlying theory of the operation of the motor-bus system is to distribute the service when practicable so as to follow the requirements of traffic, and also to utilize the best available routes from the traffic standpoint. The case made out against the bus on economical grounds does not seem a very strong one when one looks a little forward to the traffic situation.

The reverse attitude was taken by the manager of the Sheffield Tramways, who is the president of the association. Instead of giving the bus the cold shoulder and groaning over its certain financial disaster, he extended a cheerful, if not absolutely joyous, greeting to it as a valuable and perhaps necessary adjunct in doing the transportation work of a city. His railway system saw the handwriting on the wall about a year ago and has operated ten buses since near the beginning of the present year. These buses are used on four regular routes, with a fifth one soon to be opened, and have proved reliable in service. They have now run over 100,000 miles. Moreover, it is expected that next summer a still larger fleet of buses will be put in service and that routes will be extended to meet the convenience of the passengers. Still further, it is suggested that it might be an interesting and valuable experiment to take an existing railway route, on which the traffic is known, and temporarily at least withdraw the car service and supplant it by motor buses, to the advantage of the residents in the lessened noise, the absence of rails and the probability of a more frequent service.

Here are, then, two radically different and opposed opinions on the part of railway experts who have actually come into collision with the motor-bus problem. On the one hand, there is the view of conservatism, where doubtless the wish is father to the thought in the prophecy of financial failure. On the other hand, there is the view of the optimist who, seeing the possibilities for the community in a new kind of service, promptly takes it up, instead of waiting for a competitor to do so, and tries to make the most of its good features. Probably, as usual, the truth of the matter lies somewhere intermediate between the extremes.

The operating expense and depreciation of motor buses are not light. That improved construction will reduce these items is reasonably certain, but, on the other hand, the effect on the roads is so grave that undoubtedly charges must be added to the operating expense to cover this item, which sooner or later will inevitably come back on the operators of these fast and heavy vehicles. From reading the discussion and observing the conditions the impression left is decidedly favorable to the motor bus as an auxiliary, taking up as it does routes which for one reason or another may be impracticable for street cars and possessing wonderful capacity for following the movement of traffic as it shifts from hour to hour or day to day.

In America the situation with respect to operating costs is undoubtedly different from that in England. The roads are not so good and a much higher depreciation must probably be reckoned. Yet, looking at the matter in a broad way, it seems altogether probable that the motor bus will be an increasingly important factor in urban transportation where good loads of passengers can be regularly obtained.

Central-Station Saving with Electric Trucks

For several years the Schenectady (N. Y.) Illuminating Company has had in its service a number of horse-drawn wagons, electric trucks and gasoline motor-tricycles used for routine handling and delivery duty. Including various renewal costs, replacing tires, battery, etc., over a period of thirty months, Mr. C. S. Van Dyke estimates the total operating cost for the 1000-lb. truck to have been $1,600 per year, of which $564 is represented by depreciation. For the 2-ton truck, with depreciation counted at $460, running expenses at $1,603, and housing at $17 per month, or $204 per year, the total cost was **$2,267 per year.**

The gasoline motor-tricycles were adaptations of standard motor-cycles and were used for meter-setting and other light haulage jobs. Considerable trouble was, however, experienced with the breaking of their frames until adequate reinforcing was added. With these tricycles an average of twenty-three and one-fifth jobs could be completed per day, at an average cost per job of $0.199, compared with $0.244 per job for horse-drawn wagons or motor cars.

On a daily basis the cost of keeping in service the various vehicles used by the Schenectady company was as follows, exclusive of driver: Two-ton truck, $2.71; 1000-lb. truck, $3.71; one-horse wagon, $1.26; line-wagon team, $2.71; three-wheel cycle, $2.21.

After study of these costs it was decided to replace altogether the existing horse and gasoline equipment by four electric trucks, using one battery-driven 1000-lb. vehicle to take the place of three single-horse rigs, and another, a runabout, in place of the motor-tricycles. To the 2-ton truck all heavy work was then to be assigned.

The cost of operating the 1000-lb. wagon under these conditions, including driver and helper, was estimated to be $1,922, while the horse-drawn vehicles had cost $2,510 per year. Here alone a saving of $587 per year was shown, representing an annual return of about 35 per cent on the investment. The light runabout was estimated to cost $1,748 per year. The work it now does was formerly performed by two motor-tricycles, which, with employees' car fares during breakdowns, cost $1,880 per year. In addition, $459 is credited from the maintenance of the emergency wagon, bringing up to $2,340 the former expenditure now obviated by the electric wagon. The resulting annual saving is therefore $591, or 30 per cent. In the case of the 1000-lb. electric vehicle which replaces the service wagon, electric operation, it is estimated, is costing slightly more than by the former method, but the electric wagon enables nine instead of seven services to be installed daily. It also avoids idle standing, so that here again a virtual saving of $577 is estimated, a return of 22 per cent on the $2,100 investment required.

The following table gives the mileage efficiency of the Schenectady machines in kilowatt-hours per mile:

	Kw-hr. per Mile
4000-lb. truck, lead cells	1.20
1000-lb. wagon, lead cells	0.69
1000-lb. wagon, nickel-iron cells	0.85
500-lb. roadster, nickel-iron cells	0.70

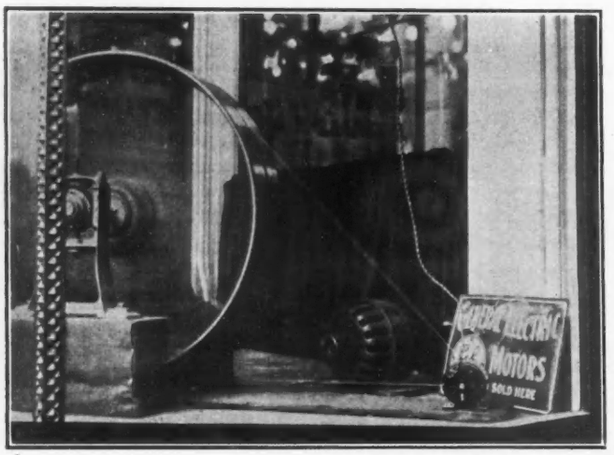
The truck and wagons average 22 miles per day, while the roadsters make 45 to 50 miles. The trucks are actually in service 280 to 290 days per year, while the roadsters are "ready" every day throughout the 365. Schenectady has 58 miles of paved streets, all within a radius of two miles from the business center.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods, and Current Practice Among Successful Utilities

An Effective Motor Demonstration

To emphasize to the laymen the compactness and efficiency of the small motor as a source of power the Worcester (Mass.) Electric Light Company installed in one of its show windows a ball-bearing grooved pulley 4 ft. in diameter and of 8-in. face, which is driven by a 1/32-hp, 110-volt induction motor through an ordinary piece of twine.



WINDOW POWER DEMONSTRATION, WORCESTER, MASS.

The contrast in size between motor and load attracted much attention, the motor diameter being hardly one-tenth that of the pulley. Both were mounted on temporary wooden blocking in the window seat, and the ease with which the little motor started the huge pulley and brought it up to full speed after a stop occasioned much interested comment from passers-by.

"We Have the Power"

The Business Men's Club of Sterling, Ill., through the efforts of the commercial department of the Illinois Northern Utilities Company, has adopted an unusual but striking slogan for attracting manufacturers to its city. This motto reads simply: "We have the power." The club has also contracted with Mr. C. B. Yonts, general contract agent of the Illinois Northern Company, for a 65-ft. sign to be erected on the bridge across Rock River. The letters in this sign are to be 4 ft. high and will be hung on a 2-in. mesh wire screen, 5 ft. high and 65 ft. long.

Electric "Showers" for Brides

Bridal "showers" of linen, books, kitchenware, glassware and the like are familiar enough. But "showers" of domestic electric appliances are not so common, and the Nashville (Tenn.) Railway & Light Company wants to know why not. It is calling attention to the subject in its newspaper advertising. The bride of to-day, it points out very truthfully, faces housekeeping problems under new conditions. Electric cooking devices and other electrical conveniences in the home will go far toward solving these problems of the newly wed. So, says the wise and kindly Nashville company, give the young woman contemplating matrimony a "shower" of these aids to domestic happiness. Make it, it implies, a regular downpour of such things as percolators, disk stoves, flatirons, curling irons, fans, toasters, electric grills, chafing dishes, heating pads and the like.

Electrically Driven Ensilage Cutters and Dry-Feed Grinders in Farm Service

On the Battle Creek Estate, not far from Muncie, Ind., motor drive has been applied to all farm machinery where savings seemed possible. The two illustrations herewith show some of the motors performing work at which they have proved particularly advantageous. In Fig. 2 is to be seen a 15-hp motor belted to an ensilage cutting and blowing machine, which cuts the green fodder into shreds and elevates it to the top of the 30-ft. silo. The induction motor, auto-starter and fuse blocks are mounted on a movable platform, so that when the services of the apparatus are required at different places on the farm a team may be hitched to the skids and the motor and starting apparatus transferred intact to the new location. Arrangements have been made for establishing service connections at several convenient points about the barn and surrounding buildings.

FIG. 1—MOTOR-DRIVEN DRY-FEED GRINDER, BUCK CREEK ESTATE

Although at present no cost data are available on this particular installation, tests made on a similar silo in an Eastern state showed that a steam engine and an engineer could be hired to cut the fodder and elevate it into the con-

tainer at a cost of $45 for a full charge. The same silo was filled the following year by means of a 15-hp electric motor operated by the farmer alone, at a total cost for energy of $16. It is estimated that with the equipment described above ensilage can be cut at the rate of 13 tons an hour.

Fig. 1 shows a small dry-feed grinder belted to the

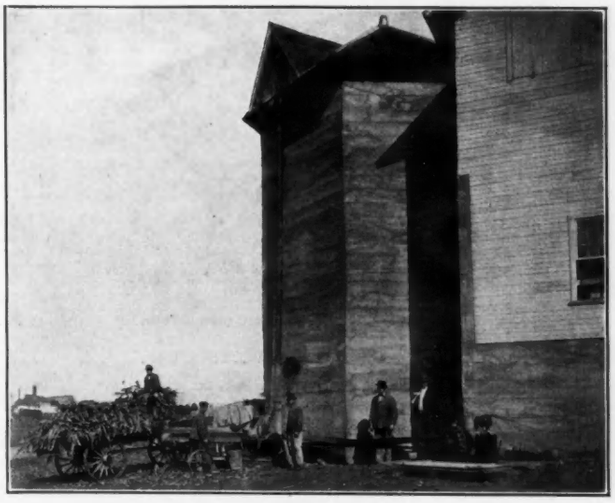


FIG. 2—MOTOR-DRIVEN ENSILAGE CUTTER, NEAR MUNCIE, IND.

countershaft in the workshop on the Buck Creek Estate. An attachment to the shafting drives a small emery wheel. The motors on this farm are all operated from the circuits of the Muncie Electric Light Company. Sixty-cycle energy is delivered to the farm over a short three-phase transmission line at 2200 volts and is transformed to 220 volts for motor service and 110 volts for lighting.

A Successful Flatiron Campaign

Under the direction of Mr. D. Kramer Gratz, representing the Electric Specialties Company of Lansing, Mich, the Indianapolis Light & Heat Company is conducting another electric-flatiron campaign, supplementing successful efforts of this kind in former years. The iron put out is known as the "Sta-hot," and the utensil is left with all domestic customers for ten days' free trial. If retained, the price charged is $2.75. The "campaign" began on Aug. 11, and up to Sept. 4 2472 irons had been placed and but 262 returned. Eleven per cent of irons returned is exceptionally low in placing flatirons.

Increasing the Efficiency of a Truck Fleet

The economies obtained with motor trucks can be greatly increased if they are kept continuously at work carrying as nearly as possible their full rated loads. Delays at the platform are serious factors in the success of a truck investment. A large wholesale grocery house in Los Angeles, Cal., which recently installed a fleet of ten motor trucks has increased the earning power of the equipment 30 per cent by the following method of eliminating delays in getting shipments started from the establishments: Sectional half-bodies of equal size are employed. These box-like sections are fitted with wheels so that they may be easily trundled about on the various warehouse floors. Overhead on each of the floors are trolley beams running to and connecting with similar beams on a large elevator. After the half-bodies have been loaded with various goods for delivery on the warehouse floors they are suspended on an electric trolley which runs on the overhead beams. From points on the different floors the half-bodies are then carried to the elevator, lowered to the ground floor and run out upon the shipping platform. There they await the return of an empty motor truck, to which they are easily and quickly applied, the two half-bodies in each case making a truck load. As all loading and routing is done within the warehouse, the entire working day of each truck is employed in actual delivery operations.

Increase in Tungsten Lamp Sales at Fort Wayne

The light and power department of the Fort Wayne & Northern Indiana Traction Company a year ago instituted a tungsten-lamp campaign with a view to reducing the free renewals of carbon lamps among the customers. Among the many advertising novelties found useful in this campaign, the demonstration board shown in the right half of the accompanying window display was considered one of the best. Mounted upon the board were successively a 10-watt, a 15-watt, a 20-watt, a 25-watt, a 40-watt, a 60-watt and a 100-watt tungsten lamp, while lower at the left was a 16-cp carbon lamp. Any of the lamps on the board could be operated through the meter, snap switches being provided for making the connections.

By this method of operation the relative energy consumption of any two lamps or any combination of lamps could be actually contrasted by interested customers who took the

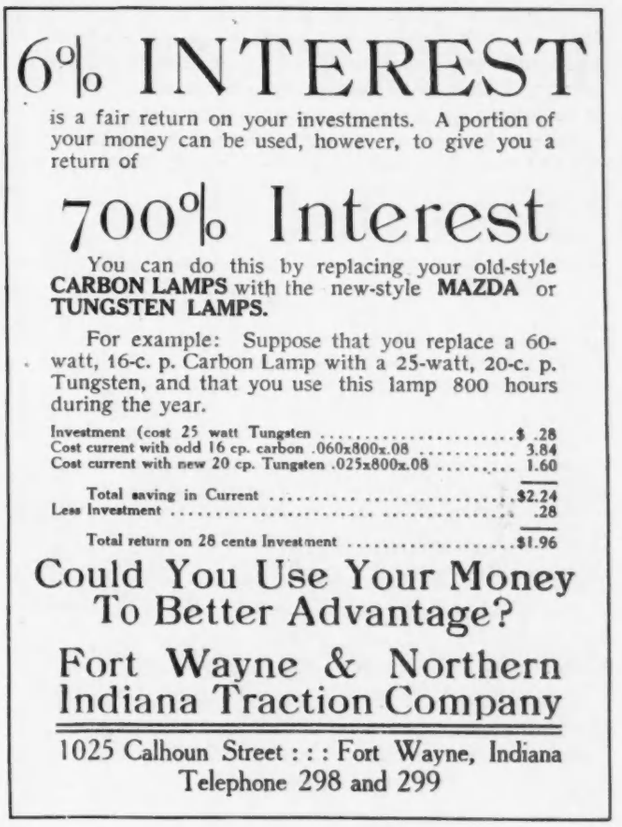
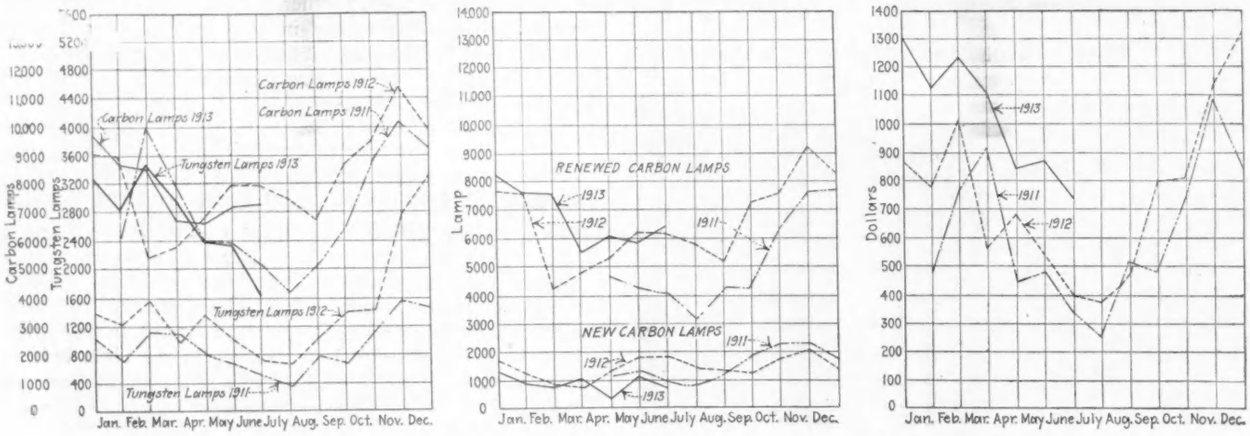

6% INTEREST
is a fair return on your investments. A portion of your money can be used, however, to give you a return of
700% Interest
You can do this by replacing your old-style CARBON LAMPS with the new-style MAZDA or TUNGSTEN LAMPS.
For example: Suppose that you replace a 60-watt, 16-c. p. Carbon Lamp with a 25-watt, 20-c. p. Tungsten, and that you use this lamp 800 hours during the year.
Investment (cost 25 watt Tungsten ..... $ .28
Cost current with odd 16 cp. carbon .060x800x.08 ..... 3.84
Cost current with new 20 cp. Tungsten .025x800x.08 ..... 1.60
Total saving in Current $2.24
Less Investment ..... .28
Total return on 28 cents Investment $1.96
Could You Use Your Money To Better Advantage?
Fort Wayne & Northern Indiana Traction Company
1025 Calhoun Street : : : Fort Wayne, Indiana
Telephone 298 and 299

FIG. 1—ADVERTISEMENT USED IN TUNGSTEN-LAMP CAMPAIGN AT FORT WAYNE, IND.

time to watch the speed of the meter disks. A small placard above each individual lamp gave its rating and its price in plain and frosted types. When the window display was dismantled the lamp board was preserved and was mounted in the room of the sales department to be used for demonstrating various lamps to buyers who were in doubt as to the size they desired to purchase. The board has become

a factor in helping customers to decide against the carbon lamps in spite of the latter's free-renewal offer, for the speed of the meter disk connected to the 16-cp carbon-filament lamp when compared with its neighbor measuring advantage the benefits of the device which they were selling.

The sheet showing the total carbon and total tungsten lamps sold and renewed speaks for itself. The improved



FIGS. 2, 3 AND 4—CURVES COMPARING TUNGSTEN AND CARBON LAMP SALES AT FORT WAYNE, IND.

the energy taken by a 25-watt tungsten lamp presents a graphic contrast.

Syndicated newspaper advertising, interspersed with original advertisements worked up in the company's office, was also freely used to aid lamp sales. One of these advertisements which seemed to be particularly effective is reproduced herewith. The promise of a 700 per cent return on an investment set many lamp users to thinking and to figuring upon what saving might be effected in their own particular case. The results of this advertising are to be seen very clearly in the accompanying curve sheet showing the returns from lamp sales plotted against the months of the year. Although the curve for November shows but little gain in 1912 over the previous year, the continued upward trend of the 1912 curve and the break in the 1911 curve at Dec. 1 show that the spirit of enterprise was making itself felt. The 1913 curve, although following the general shape of the curves of the previous years, shows an increase in the volume of sales which was in advance of any former yearly increase.

Referring to the curve sheet which gives the number of carbon lamps renewed monthly and the number of new carbon lamps sold, it will be seen that the effect of the

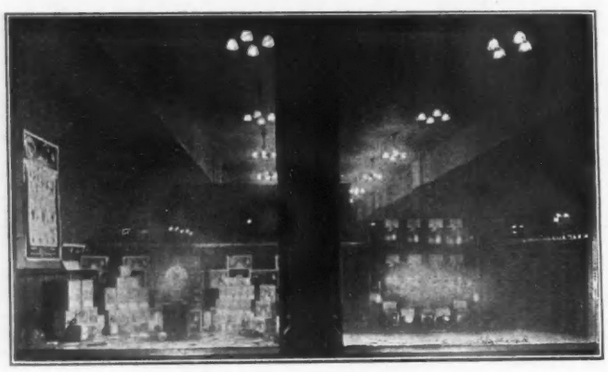


FIG. 5—WINDOW DISPLAY USED IN TUNGSTEN-LAMP CAMPAIGN AT FORT WAYNE, IND.

tungsten campaign made itself felt from the very beginning in the sale of new lamps. That the renewal curves for the latter part of 1912 are at all above those of previous years is ascribed to the fact that lamp and appliance solicitors in house-to-house canvasses have used inquiries regarding lamp renewals as a means of obtaining admittance to customers' houses in order to extol to better commercial methods have kept the tungsten curve for 1913 well above all previous records, while the carbon lamps are slowly but surely losing prestige.

The Electric Vehicle and the Central Stations

The fourth annual convention of the Electric Vehicle Association of America, held at Chicago Oct. 27 and 28, was reported in a general news account appearing in the *Electrical World* of Nov. 1. Following are abstracts of several of the remaining convention papers of special central-station interest, together with brief accounts of the discussion they caused.

The Merchant and the Electric Truck

In his paper entitled "The Merchant, the Central Station and the Electric Truck" Mr. F. Nelson Carle, General Vehicle Company, Long Island City, N. Y., said that central stations have a great opportunity to aid in introducing the electric truck, since they act in no small degree as consulting engineers to their local industries and communities. The confidence which the public already imposes in the central station should be capitalized in building up a demand for the electric truck. In discussing the problem of distribution the author emphasized the principle that the most economical method of distributing merchandise consists not in the blazing of new trails but in utilization of existing channels. Since the central-station company enjoys both the local rate and the yearly-quantity rates in advertising in the daily papers of its community, Mr. Carle urged that the company should use these mediums more to popularize electric vehicles. In support of this contention he added that advertisements signed by the central station carry more interest and more conviction than those coming from outside manufacturers. The author commented upon the educational work of the Electric Vehicle Association of America. In closing he declared that if central stations would look upon the 10,000,000 city horses as 10,000,000 small isolated plants, and pursue this problem with the same energy as is devoted to real isolated plants, the merchant, the central station and the electric-truck manufacturer would soon all be doing a more remunerative business.

Discussion

In the discussion Mr. C. D. Marsh, of New York, emphasized the fact that the public has more confidence in an electric-vehicle indorsement coming from the central station than in one from the manufacturer. Mr. E. E. Witherby spoke of the inconsistency which some central

stations display toward the electric vehicle, adding that one company had just ordered eighteen gasoline trucks for its own use. Mr. Day Baker said that remarkable success in the sale of electric vehicles has attended the encouragement given by New England central-station companies. Mr. G. D. Smith, of Cleveland, suggested that the members of the vehicle association attend central-station conventions and present their views to the electrical men. He spoke of the results attained by committees in the Ohio and Indiana central-station associations, citing the establishment of vehicle departments by several electric-service companies in those States.

Mr. E. H. Hewins, of Boston, defended the central stations against the criticism offered concerning them. He recently visited forty cities and said that all of these central stations were assisting in the vehicle campaign. Mr. E. S. Mansfield, Boston, suggested that electric-service companies and vehicle manufacturers combine in campaign efforts rather than act individually. Mr. J. A. Hunnewell Lowell, Mass., advised that all central-station men be asked to join the Electric Vehicle Association, and spoke of his own personal efforts to keep Eastern companies informed of the work being done by the association.

ELECTRIC-VEHICLE SALESMANSHIP

In this joint paper Messrs. George H. Kelly and E. J. Bartlett, of Cleveland, Ohio, declared that the important problem now presented to the association is one of co-operative salesmanship between the electric-vehicle manufacturer and the central-station operator. The authors believe that there has been entirely too much criticism of the manufacturer by the central station and of the central station by the manufacturer. The Baker Motor Vehicle Company recently instituted a plan which, it was hoped, would draw central stations and manufacturers together into a well-defined, systematic and harmonious relationship. The results, however, have been very discouraging. From 1400 central stations solicited but twenty replies were received, and not all of these were favorable. In commenting upon the opportunity of the association for reaching both parties to the controversy the authors included ten suggestions as an outline of the work which in their opinion the association might profitably carry on. Most of these suggestions were relative to circularizing the central-station field with electric-vehicle literature and matter of interest from the salesman's viewpoint. It was suggested that this canvass be made in the 228 cities having a population of more than 25,000.

Discussion

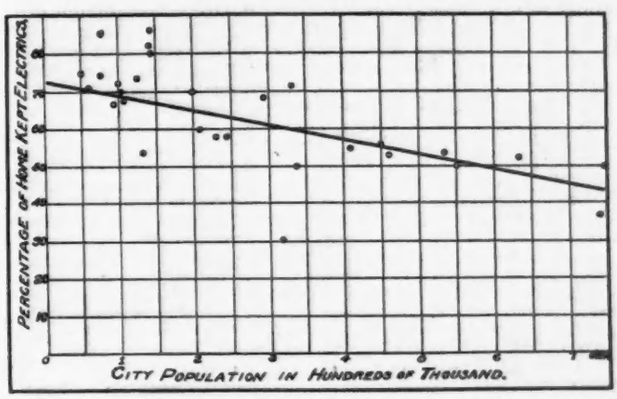
Considerable discussion followed, among those taking part being Messrs. C. K. Chapin of Memphis, F. C. Creager of Chicago, Hayden Eames of Cleveland, W. H. Conant of Washington, E. S. Mansfield of Boston, E. M. Jackson of Denver, E. E. Witherby of Chicago, and F. W. Smith of New York. Mr. Chapin suggested that it would be a good idea for manufacturers' representatives to visit the electric-service companies rather than ignore them. Mr. Creager believes that manufacturers should furnish the central stations with more data on the operating cost of electric vehicles, as that is the subject in which the latter are most vitally interested. In answer to this Mr. Eames stated that considerable data have been furnished by manufacturers and published in technical journals. He mentioned articles which have appeared in the *Electrical World* during the last few years.

Mr. Jackson stated emphatically that the Denver Gas & Electric Light Company can afford to support a vehicle department, as the revenue from 914 vehicles was $6,720 during the month of September. He added that by allowing the head of the vehicle department to attend vehicle conventions and visit the various vehicle and battery factories his company is in a position to give its consumers excellent advice on the type of car to use and how to maintain it.

CHARGING OF VEHICLES IN UNATTENDED GARAGES

Among the interesting curves presented by Mr. Maxwell Berry, of the Electric Products Company, Cleveland, Ohio, in his paper on charging equipment for private garages, was one showing the percentages of electric vehicles garaged at home in cities of various sizes. The figure ranges from 75 per cent in places of 100,000 population down to 45 per cent in cities of over 700,000 where land is more expensive and apartment-house and hotel life is more general. Expert attention is also, of course, more prevalent in public garages in the larger cities, explaining the tendency away from private stabling. The field of the private electric garage in smaller communities is therefore a large one and has not reached the degree of saturation observed in large cities.

For proper vehicle charging in an unattended garage it is essential, said the author, that the batteries receive a suitable current strength for a suitable period. Mr. Berry then passed to a description of standard charging methods, pointing out their advantages and drawbacks and closing with an account of the automatic "soakometer" control of a vertical rotary rectifier. A cut-off pointer on the voltmeter scale opens the circuit when the proper charge has been given. Occasional overcharging is automatically provided by a clock hand whose slow movement gives an adjustable soaking charge of fixed duration after the normal charge is finished. The presence of a short-circuited cell is indicated by the failure of the lower pointers to engage. Positive indication is also given when the charge has been completed, leaving no doubt that interruption has been caused by line troubles.



PERCENTAGE OF HOME-GARAGED CARS IN CITIES OF VARIOUS SIZE

STANDARD CHARGING PLUGS DISCUSSED

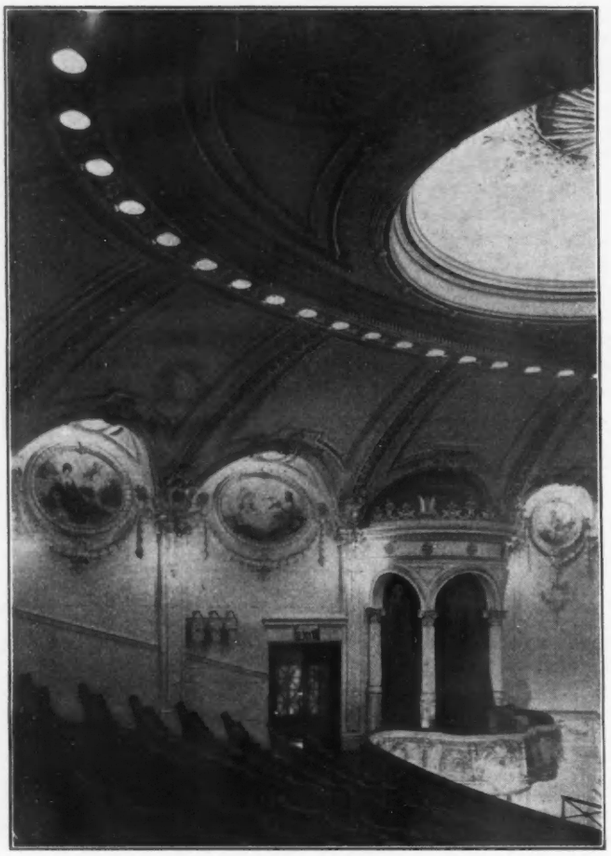
On recommendation of the standardization committee the association voted to recommend as standard practice a larger plug in addition to the standard charging plug already adopted; also that the outside terminal be made positive and the inside terminal negative. The committee reported that it is considering standardization of tires, speed and mileage on one battery charge, automobile lamps and data sheets. Mr. Chapin, of Memphis, Tenn., declared that several operating companies have thought that the concentric plug was not what it ought to be. The subject should be considered in connection with the standardization of plugs for other electrical purposes, and the co-operation of the National Electric Light Association should be sought. "Yes, and that of the Society of Automobile Engineers also," supplemented Mr. W. H. Conant, of Washington, D. C.

Mr. Ralph Temple, an automobile dealer, of Chicago, gave a brief talk. He dwelt especially on the value of organization, which, he said, means education, and that is the groundwork of success. Mr. Temple believes in the agent giving free inspection service.

Illumination and Wiring

Decorative Lighting in a Theater

A decidedly novel method of lighting a London moving-picture theater is shown in the accompanying illustration. The method is interesting as showing how the indirect



INTERIOR LIGHTING OF LONDON THEATER

method of lighting can be introduced without giving rise to the impression of "flatness" of which some people complain.

It will be seen that the greater part of the light is derived from the illuminated dome. This dome has a blue and gold style of decoration, so that it gives, in a sense, the effect of an "artificial sky." It is lighted by twelve concealed 25-cp amber lamps. Round the dome is a ring of forty-eight amber lamps above diffusing glass disks. The remainder of the lighting is provided by concealed lamps, which also serve to illuminate the decorative painted panels in the background.

The objection of "something missing" sometimes urged against indirect lighting seems to rest on a psychological basis. People are so used to the idea of having a lamp in a room that when the room is lighted without any apparent source there is a feeling that the installation is somehow incomplete. The use of a dome, as shown in the illustration, seems to avoid this impression. The brightly illuminated dome surface is involuntarily accepted by a person entering the interior as being separate from the ceiling and itself constituting a source of light. The feeling of flatness is also skilfully removed by the use of the concealed lighting over the panels. Altogether the effect in this theater is decidedly novel. The lighting scheme was worked out simultaneously with the design of the building, and the installation shows what a decided advantage it is when the architect and lighting engineer combine in this way.

The use of a colored lighting effect (in this case, as stated above, the lamps are mainly amber, but some are orange) is becoming common in theaters. Besides its decorative value, this method seems to have another advantage. It separates the general lighting of the theater from the lighting of the screen. It is becoming usual in some of the London theaters merely to dim the lighting but not to turn it off completely while motion pictures are being shown. It may be suggested that when this is done the "color-separation" idea alluded to above has a certain value. It may be added that in this theater the lamps are turned on and off gradually by means of a dimmer. This practice should be generally recommended, for the abrupt shock caused by sudden switching on of the lamps in picture theaters is admittedly trying to the eyes.

The photograph shown in the illustration, which was taken entirely by the artificial light, illustrates the high degree of perfection to which artificial light photography has now attained. It is of interest to mention that the exposure had to be done in two stages, the central dome being illuminated for only a portion of the time. Otherwise an exposure sufficient to bring out the panels in the background would have been too much for the brightly lighted pattern in the interior of the dome and the detail in this part of the picture would have been lost.

Electric Service in a Department Store

For many months before Stern Brothers' new store on Forty-second Street, opposite Bryant Park, in New York City, was opened for business a huge electric sign on the front of the uncompleted structure told passers-by that the store was to be supplied with electrical energy from the mains of the New York Edison Company. At night the illuminated sign, centered on the broad face of the building, did much to call attention to the fact that the department store would soon move to its new home. Behind the doors shown in Fig. 1 are hung the three electroliers shown in Fig. 2. The fixtures are of bronze and all of the light is

FIG. 1—ELECTRIC SIGN IN FRONT OF STERN BROTHERS' NEW STORE BEFORE COMPLETION OF BUILDING

furnished from the twelve small globes suspended from the canopy of the unit.

The principal selling floors are lighted by a fixture shaped somewhat like an acorn. The bulb is provided with five sides, and each panel is made of a glass containing blue and opal hues so that the resulting light is much whiter than is ordinarily given by the tungsten lamp. In the top of the reflector is concealed an indirect ventilating device which

carries off the heat from the lamp without allowing light rays to play directly upon the ceiling. By this method streaks and spots on the white surface above are avoided. The height of the ceilings differs on the various floors, but all are approximately 17 ft. In all instances the lamps are suspended at a distance of 10 ft. from the floor, this height having been selected after several trials at different elevations. Two of the acorn units are hung in each bay

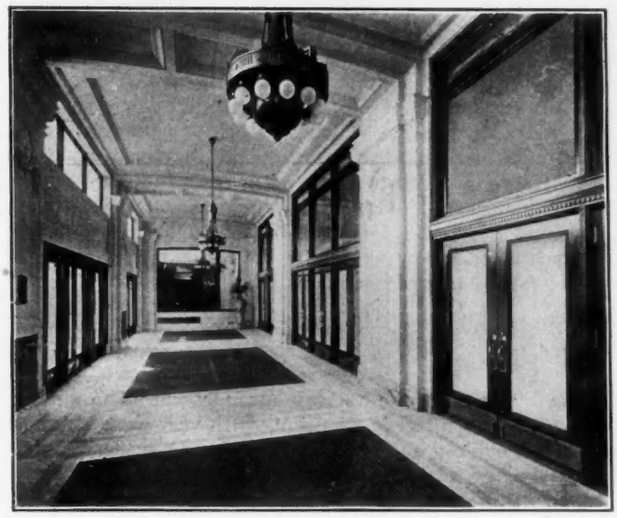


FIG. 2—THREE ELECTROLIERS IN LOBBY OF STERN BROTHERS' STORE

and spaced 11 ft. on centers in one direction and 21 ft. on centers in the other direction. Throughout the entire installation 250-watt German tungsten lamps are used. The upper floors are lighted with tungsten lamps and open reflectors. The showcase illumination is furnished by standard I. P. Frink linolite units.

The cubical content of the building has been estimated to be approximately 10,000,000 cu. ft. and the total connected lighting load is about 750 kw. There are in all 280 lighting

FIG. 3—ACORN UNITS USED ON PRINCIPAL SELLING FLOORS

units which supply the general illumination for each of the selling floors.

The central-station services enter the building at three separate points and the local feeders are distributed from seven groups of panelboards. All ceiling outlets are controlled from push-buttons located on panelboards. The showcases, which are fed from floor outlets, are locally controlled by switches at each case. The wiring in all parts of the building follows the standards used in all buildings of the present day, which have been described from time to time in these columns.

Seventy-seven motors, ranging from 1.5 hp to 35 hp in rating and aggregating approximately 1235 hp, are used to drive twenty-five elevators, ten dumb-waiters, a pneumatic-tube system, a vacuum-cleaning plant, a ventilating system, carriage calls and many other devices. Some of the freight elevators have been made large enough to accommodate the motor trucks of the firm, and the loaded vehicles are run into the elevator and taken to the desired floor for distribution of their contents.

The lighting fixtures and electroliers were furnished by Cassidy & Son, New York, and all wiring and installation was done by the firm of J. Livingston & Company, of the same city.

Chauffeur's Reading Lamp

The electrical equipment of the modern automobile is generally so complete that it antedates popular demand, and the automobile manufacturer really educates the public to his standard of convenience. Occasionally, however, details have escaped notice and a car owner improves upon the factory product. Mr. Arthur Fox, of Brooklyn, N. Y., the owner of a Hudson car of the 1912 model, has added a portable electric reading lamp to his automobile which is interesting because of its diversified utility. The equipment consists of an 8-ft. flexible insulated conductor having at one end a miniature lamp, reflector and socket and at the other an attachment plug. The lamp is of the 6-volt type, and although of small candle-power, it gives sufficient light for reading or for examining the engine. The home-made reflector is permanently attached to the socket and is equipped with a screen for guarding the lamp. The attachment plug fits the socket in the side-lamp receptacle. For reading while waiting at railway stations Mr. Fox suspends the small lamp and reflector from the diagonal ribbons in the automobile top just above the wheel.

Grounding to Water Mains in Arid Districts

In the southwestern section of the State of Texas, where rains are infrequent compared with the amount of precipitation enjoyed in other districts, the problem of obtaining adequate grounds for electrical purposes is often one of great difficulty. Mr. John A. Walker, of the San Angelo (Tex.) Water, Light & Power Company, reports that at San Angelo the plan of driving pipes into the earth and connecting ground wires to them has been tried, but in most instances it was found that the grounds thus obtained were not sufficient to carry off any considerable amount of current. After a prolonged season without rain the earth surrounding the pipe would soon become very dry and for all practical purposes almost an insulator. The surface soil, however, might be moistened by an occasional shower, so that under these conditions a very considerable difference of potential could exist between the end of the ground wire and the surface of the ground. The plan of burying plates of copper or cast iron deep in the earth was next tried, but with little better results.

The company then began to make use of the local water-main system, and its experience seems to show this to be the only method that is really satisfactory in this locality. In making the connections to the mains a 7/16-in. hole is first drilled in the hub of the pipe, the hole then being tapped out and refilled with a brass tap screw having a solder lug. As no current flows normally through this connection there is little possibility of trouble from electrolytic action.

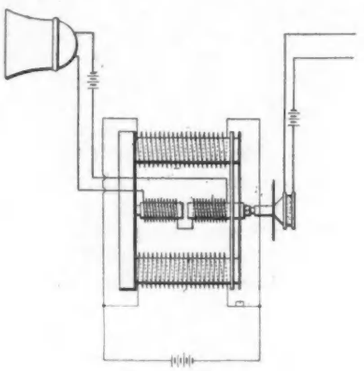
Considerable paving was laid in San Angelo during the last two years, and the company made it a special point to

have grounding wires put down in advance of this work, wherever there was any likelihood of needing such ground connections for present or future use. From its own experience the company further recommends having each ground wire well protected near the surface by passing through and being connected to a 0.5-in. pipe, which should extend up the pole about 8 ft. Otherwise the wire may break off or be cut near the ground line, a condition which, remaining long undiscovered, may introduce a serious element of danger.

Recent Telephone Patents

A patent granted to Mr. W. P. Stung, of Lansdowne, Maryland, under the title "cushion for diaphragms" describes a spring-wire cushion piece to form the mechanical support of the diaphragm. A ring of spring wire bent into several different planes forms a cushion between the diaphragm and the usual peripheral seat. This device is used to improve the sensitiveness both in repeaters and receivers.

A method of constructing a repeater invented by Mr. C. Adams-Randall, of Boston, Mass., is shown in the accompanying illustration. The right-hand middle core is free to move, being supported solely by a thick spring strip, the end of which rests upon the poles of the magnet. The movement of this core under the combined influence of the various magnetic fields drives the movable electrode of the transmitting part.



NEW REPEATER

Duplex System

A duplex system of telegraphy designed for the simultaneous transmission of two independent messages over the same wire in opposite directions is described in a patent granted to Mr. S. Kitser, of Philadelphia, Pa. There is no reciprocal facility but the circuit is designed to permit continuous transmission in both directions. The operation of the system depends upon maintaining the receiver terminals at equipotential for the instantaneous values as far as effects from the transmitter of its own station are concerned. To this end two induction coils, one of which is adjustable, are provided for the transmitter. Both secondaries are included in the line at each end, and the receivers are bridged across the terminals of the adjustable coils. As the coils at one end act simultaneously, adjustment of the auxiliary coil must be such that it raises the potential at the line terminal of the receiver just the amount that this would be lowered by the primary coil acting through the combined effective resistance of line and apparatus.

A step-by-step call system has been invented by Mr. O. N. Lindsey, of Senatobia, Miss. In this system each impulse serves to connect the call apparatus at one station while the succeeding impulse serves to disconnect it. Impulses of a different sort serve to release all apparatus and permit everything to come to the zero position when any accident occurs.

Letter to the Editors

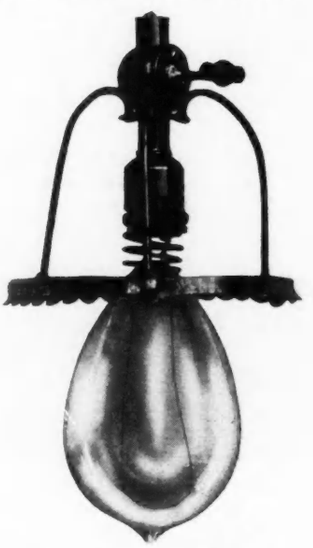
A Veteran Incandescent Lamp

To the Editors of the Electrical World:

Sirs:—In your issue of Oct. 11 I read with interest a note on "A Veteran Incandescent Lamp," but I believe that the lamp I am sending you [shown in the accompanying photograph] can go the preceding instance "one better." This early English lamp, which was taken from the home of Mr. B. B. David, of Cheyenne, Wyo., about eighteen months ago, when his house was rewired, had previously seen service for twenty-three years. Mr. David reports that his installation of electric lighting was first supplied from a storage battery which was placed under the front porch. These cells were charged daily by the local company. It is also claimed that some of the first incandescent lamps used in this country were installed here in Cheyenne in the old Popp Block, although this we have been unable to verify except by the testimony of some of the old inhabitants of the town.

Theodore Thiele,
Superintendent Wyoming-Colorado Engineering Company.
Cheyenne, Wyo.

[The filament of the veteran incandescent lamp shown herewith is still intact in its twenty-fifth year even after its recent 2000-mile parcels-post journey to this office. Attention is directed to the method of mounting the lamp proper, a construction which at first glance might seem to anticipate the latter-day shock absorber for tungsten units. In fact, however, the large helical spring merely serves to hold firmly in place the wire hooks engaging the leading-in wires—themselves a small fortune in platinum—and, except for lateral flexibility, the mounting is fairly rigid against transmitted shocks. The base and receptacle are of the bayonet-joint type with spring contacts resembling closely those of a modern door-bell push-button. The switch casing, made from a brass casting turned up in a lathe, is highly reminiscent of gas-valve design, as are also the 0.25-in. threaded fittings and the set-screw holder for the glass shade. Mute stumps projecting from the gas-fixture-like stem reveal that this particular socket was last wired up with No. 18 bell wire covered with paraffined cotton, the positive and negative conductors being very carefully distinguished by the use of yellow and green wrappings which still retain all their original beauty and luster. This interesting relic shows how far indeed electrical construction has come in the quarter century spanned by this sturdy unbroken filament.—Eds.]



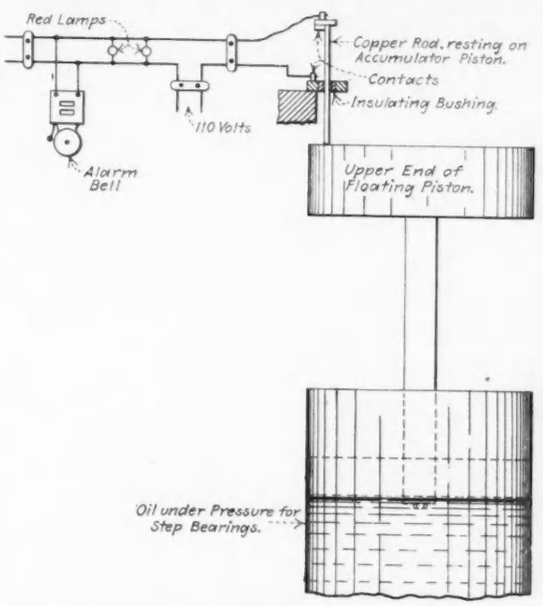
VETERAN INCANDESCENT LAMP

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Alarm Circuit for Step-Bearing Accumulator

Trouble is always in store for an engineer of a turbo-generator station if the oil pressure on the step bearings is not maintained. In order that such a condition shall be detected as soon as the pressure falls the operating force of the Marion (Ind.) Light & Heating Company has placed in operation an alarm circuit the essentials of which are given



ALARM CIRCUIT WARNING ENGINEER IF STEP-BEARING OIL PRESSURE DECREASES

herewith. As will be seen from the drawing, a copper rod rests upon the top of the accumulator and when the pressure of the oil is holding the piston afloat the top of the rod is about 5 in. above the alarm contact. Should the pressure fall, the contact on the movable rod and the one on the stationary guide will be brought together by the downward movement of the piston and the electrical circuit will be completed, ringing the alarm bell and lighting the two red lamps which have been included in the circuit.

Scotch Mechanical Stoker with V-Grate

The interest of English engineers has been aroused by a new stoker invented by a Scotchman, the feature of which is its V-shaped grate. One of these furnaces has recently been in experimental operation at Motherwell in large steel works, where it has been applied satisfactorily to a pair of water-tube boilers of the Babcock & Wilcox type. It is also being applied to other types of boilers in different works in the west of Scotland. The fire-bars rest on an ash trough situated at the bottom of the flue, and the top part of the firebars forms a short platform along which the coal is conveyed on either side by two interrupted screws. These coal-feeding screws take the fuel from hoppers at the front of the boiler and gradually feed it along the whole length of the furnace. The interruptions are so arranged that there can be no banking of coal on any particular part along the line of the furnace. Should the fuel burn out more rapidly at any point the new coal finds its way there and supplies the deficiency. In the ash trough there is an extracting screw which breaks up the clinker and takes the ashes uniformly from the back to the front of the furnace. The feeding of the coal and the extraction of the ash are thus both automatic, and are regulated so as to work in unison. The furnace is claimed to be absolutely smokeless and to give higher coal and boiler efficiency, with the expenditure of very little labor, than the older methods of stoking and cleaning.

Insulating and Grounding Motors and Generators—II

BY TERRELL CROFT

Where a motor or generator that is directly connected to some prime mover or machine must be insulated therefrom, it is necessary to insert an insulating coupling in the shaft between the electrical machine and the other machine. The construction of one type of such a coupling is outlined in Fig. 6. A disk, usually of fiber, is bolted between the two faces of the flanged coupling, and the coupling bolts are insulated with washers and bushings, which are also usually made of fiber. Couplings of the type outlined in Fig. 6 are not self-aligning; i.e., the only members that prevent the two shafts from being forced out of line with each other are the bolts through the coupling. It is necessary, therefore, where a coupling of this type is used, to have a bearing supporting the shaft reasonably close to and at each side of the coupling. It is difficult to design an insulated self-aligning coupling, and where one is designed it is ordinarily quite expensive. Hence it is usually cheaper to provide the additional bearings required with a coupling of simple construction, like that of Fig. 6, than it is to install a self-aligning bearing and thereby eliminate possibly one or two bearings.

It is practically impossible to insulate a large heavy direct-connected electrical machine in such a way that it will remain in accurate alignment with the prime mover that drives it or the machine that it drives. For this reason it is the almost invariable practice to ground such machines.

Where belt-driven electrical machine frames are insulated from the ground, trouble frequently results from

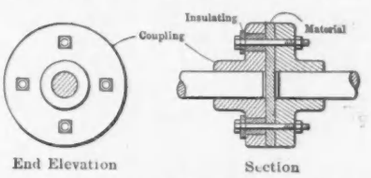


FIG. 6—TYPICAL INSULATING COUPLING

static electricity generated by belt friction, which, because it cannot find a low resistance path to ground through the machine frame, will discharge from the belt driving or being driven by the machine, or may discharge from some portion of the machine frame to a grounded object. While these static discharges may not be dangerous to life, it has

been found that they frequently have an injurious effect on the insulation used on the windings and sometimes cause breakdowns. A metallic comb, connected to ground, arranged close to but not touching the belt that tends to discharge static electricity, will usually eliminate the discharges, or grounding the frame of the machine, if grounding is permitted, should accomplish the same result. If

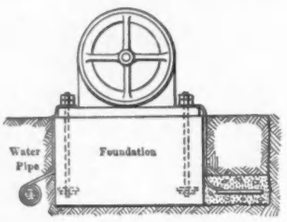


FIG. 7—GROUNDING A MACHINE FRAME ON A PIPE AND ON A GROUND PLATE

direct grounding of the frame is not permitted, a high resistance ground, consisting of a piece of ground-glass having a lead-pencil mark on it, possibly an inch long, can be used in series between the generator frame and the ground. A sheet-metal terminal should make contact with each end of the pencil mark, and to these metal terminals are connected respectively the leads to the ground and to the frame of the machine. Although the resistance of such a pencil mark is exceedingly high, the static electricity will readily flow through it.

Probably the best method of grounding a frame is to connect it to a water pipe. As noted above, the frames of generators directly connected to steam prime movers are thoroughly grounded through the steam and exhaust piping to the engine. Fig. 7 shows two methods of grounding the frame of a machine. At the left of the arrangement a ground conductor is connected, in a manner to be described hereinafter, to the frame of the machine and to a water pipe. At the right the ground conductor connects to a metal plate embedded in charcoal. The method of constructing a ground connection with a metal plate and charcoal is described in detail in the National Electrical Code. To be effective the charcoal must always be moist, and it is not always that this condition can be assured. Where a ground connection for any purpose is required and a water pipe is not available, it now appears to be the accepted practice to drive a series of ground pipes into the earth somewhat after the manner indicated in Fig. 11.

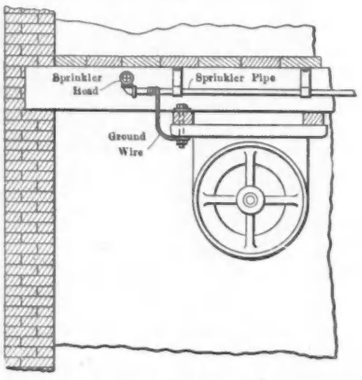
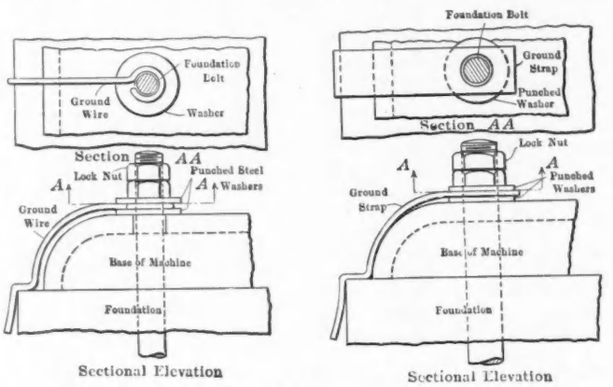


FIG. 8—MOTOR FRAME GROUNDED TO SPRINKLER PIPE

In Fig. 8 is detailed an installation wherein a motor mounted on a ceiling in an industrial plant is grounded to a sprinkler pipe. In buildings of non-fireproof construction sprinkler pipes are usually available and constitute an excellent method of securing a good ground. Some judgment should be used in grounding a motor frame to a sprinkler pipe. A very large motor should not be grounded on a very small pipe. It is probably permissible to ground a 10-hp or 15-hp motor to a ¾-in. branch pipe, but a 50-hp motor should be grounded on one of at least 2-in. nominal diameter. The pipe selected should in every case be of such size that there would be no possibility of its overheating when carrying the current which the fuses protecting the motor will safely convey. Obviously, if the current through the motor frame and ground wire to the sprinkler pipe becomes greater than that which the motor fuses will pass, the fuses will blow and open the circuit.

A system of ground pipes for grounding a large capacity electrical machine in a location where no water pipe is available is outlined in Fig. 11. A series of ground pipes, which should extend far enough into the earth so that a good portion of their lower ends will always be in damp soil are driven into the ground around the foundation of the machine. These pipes are all connected in multiple with a heavy ground wire, one end of which is carried up to and connected on the frame of the machine. It should be understood that this multiple ground-pipe connection is not nearly so good a one as that provided by a pipe connecting to an extensive water system.

Figs. 9 and 10 show two methods of connecting ground conductors to frames of electrical machines. In Fig. 9 a ground wire is shown. Where wire is used it should always be of sufficient section to carry, without appreciable



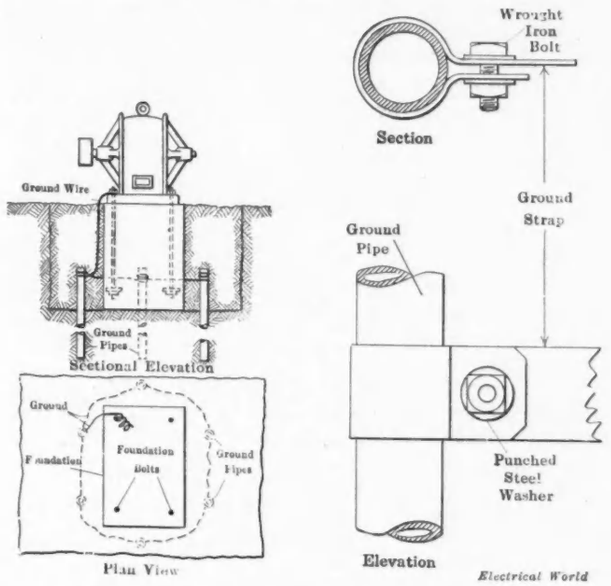
FIGS. 9 AND 10—METHOD OF CONNECTING GROUND WIRE TO MACHINE AND METHOD OF CONNECTING GROUND STRAP TO MACHINE

heating, the current that the fuses protecting the machine will pass. It should also be of such size that it cannot be accidentally broken. The wire is clamped between two punched washers by a nut turning on the bolt that holds the base of the machine to the foundation. These punched washers should be used to insure effective clamping, and so that the nut in being turned on the bolt will not dig into the wire. It is a good plan to provide, as shown, a lock nut on top of the first nut which will prevent loosening if there is vibration. Sometimes the two punched washers and the end of the ground wire are "tinned" in order to prevent the corrosion that might otherwise be caused at the point of contact between the bare copper and iron. The end of the ground wire should be bent around the bolt in the same direction that the nuts turn on—that is, in a right-handed direction—so that any twisting action due to the nuts will tend to wrap the wire around the bolt rather than to unwrap it. Copper should always be used for ground wire.

A strap of copper is used for the ground connection of Fig. 10. In general, the requirements for the strap as regards mechanical strength and current-carrying capacity are the same as those for a ground wire, as outlined in the above paragraph. Where a large machine is being installed a strap connection is preferable to a wire, because with it sufficient cross-section can be secured in a form that can be readily bent into any desired contour. A large

round wire cannot be conveniently formed around the foundation, into the corners and around the bends which it must follow in its route to the earth. Where a strap is used it can be of possibly ⅛-in. thickness and of sufficient width to provide the necessary current-carrying capacity, and it can always be formed without difficulty into any desired contour. The end of the strap clamped between the punched washers and the washers themselves should be "tinned" to prevent corrosion.

A ground wire, if it be not too large, can be connected to the ground pipe with one of the specially designed clamps of which there are many forms in the market. If clamps are not available, the point on the pipe at which it is desired to connect the ground wire should be carefully cleaned, and the ground wire can be soldered thereto. In soldering a copper wire to an iron pipe, the pipe should be filed until it is bright and should be "tinned" by heating it,



FIGS. 11 AND 12—ARRANGEMENT OF GROUND PIPE AROUND AN ISOLATED MACHINE AND METHOD OF CONNECTING GROUND STRAP TO PIPE

using powdered sal ammoniac as a flux and applying the solder. The previously "tinned" end of the ground wire is then wrapped around the pipe several times, the whole heated and solder applied.

A ground strap can be connected to a pipe as detailed in Fig. 12. The pipe should be clean at the point where the strap clamps around it, and both the strap and the pipe should preferably be "tinned."

Meaning of Diversity Factor

I have heard the term diversity factor used in so many different ways that I should be glad to have its correct definition. B. E.

By diversity factor is meant the ratio between the simultaneous demand of a number of individual services for a specified period and the sum of the individual maximum demands of those services for the same period. It is expressed in per cent and can never be greater than unity unless expressed in terms of its reciprocal.

Value of the Standard Volt

Will you kindly publish the present value of the standard volt, which I understand was recently changed slightly? A. G. A.

On Jan. 1, 1911, the Bureau of Standards by international agreement introduced a slight change in the standard volt. The electromotive force of the Weston normal cell was changed in rating from 1.01913 volts at 20 deg. to 1.01830 volts at 20 deg. C., a reduction of 0.08 per cent, or, expressed in another way, the new standard volt was increased in magnitude by 0.08 per cent. The standard ampere became likewise a larger unit to a similar extent and the watt, or unit of power, became increased by 0.16 per cent.

Testing High-Tension Switchboard Wiring

Is there any recognized standard test for high-tension switchboard wiring? If so, what are the working voltages? S. E. A.

It has been recommended that all high-tension switchboard wiring be subjected to high-voltage tests before use. Such tests should approximate at least two and one-half times the working pressure of the system for a period of at least five minutes, and preferably for thirty minutes. The insulation most favored for this class of work is varnished cambric protected by a slow-burning outer covering, if installed without lead sheath. Careful attention should be paid to methods of installation such as the separation of conductors, freedom from loops, stability of supports, accessibility for repairs or renewals, etc.

Operation of Transformers in Parallel

Is it possible for two transformers of similar size and rating not to operate satisfactorily in parallel? M. T.

In order to secure perfect parallel operation transformers of the same rating should have exactly the same ratio of high-tension and low-tension turns, the same *IR* drop and the same impedance drop. For all practical purposes, however, two transformers having the same ratio of turns and approximately the same impedances will operate satisfactorily in parallel even if the *IR* drops are different. Duplicate transformers ordinarily should possess the same characteristics and share the load equally. Transformers of different make may possess different characteristics, so that measurement should be made to determine if each will carry approximately its share of the load. Where the impedances differ the load on the transformer with the smaller impedance will be greater than that on the other transformer, the portions of the load assumed by the two units being approximately in inverse proportion to the two impedances.

How to Obtain Government Records

Will you kindly advise me what steps to take in order to obtain government publications? B. W. J.

Government publications are in general classed either as congressional or departmental documents and are deposited for distribution as follows: (1) With the document rooms of the Senate and House of Representatives, (2) with the bureau under which the work is carried on, and (3) with the superintendent of documents. Publications from the document rooms of the Senate and House of Representatives are distributed only on the order of members of Congress, to whom all applications for congressional documents should be sent. Most of the departmental publications deposited with the bureaus in which the work is done are distributed free of charge, although a nominal price is placed on certain issues in order that they may not fall into the hands of persons other than those who actually need them. All publications deposited with the superintendent of documents are sold, the price fixed being only sufficient to cover the cost of paper, press work, binding and distribution. Most government bureaus issue complete indexes, bibliographies, maps and other guides to the results of their work, and the *Monthly Catalog, United States Public Documents*, issued by the superintendent of documents, gives a complete list of all government reports issued during each month.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

High-Frequency Alternator.—Bouthillon.—A mathematical article in which the author shows that by superposing in a conductor a certain number of periodic emfs of equal frequency with proper phase differences between each other, a resulting emf is obtained with a frequency which is a certain multiple of the original frequency. By this means it is possible to obtain in a polyphase alternator with windings of the ordinary type currents of an increased frequency. The two types of machine studied by the author are alternators with a rotating iron core, permitting high speeds of rotation. His calculations show that, using a peripheral speed of not more than 196 m per second, it is possible to design a machine of more than 100 kw output with a frequency of 96,000 cycles per second. This type of alternator is thought to be suitable for wireless telegraphy.—*La Lumière Elec.*, Sept. 13, 1913.

Double-Commutator Machines.—Karl Pichelmeyer.—With the aid of the Ossanna voltage polygon diagram it is shown that in machines with a double commutator the voltage conditions are in general not the same on both sides of the machine. This point has to be taken into account in estimating the distribution of the load of the two commutators and in the choice of polyphase connections, etc.—*Elek. u. Masch.* (Vienna), Sept. 14, 1913.

Dynamo with a Central Pole.—An article on a machine which, as shown in Fig. 1, is characterized by two concentric primaries, one in the center and the other at the periphery, the two being of opposite polarities. The peripheral primary may be replaced by several pole pieces all of the same polarity, which may enter into the central space in a more or less pronounced way as shown in the illustration. This sketch shows four secondaries turning around the axes *A, B, C, D*. Such a machine permits obtaining high tensions and high frequencies and allows variation of the armature reactions within rather wide limits.—*La Lumière Elec.*, Sept. 27, 1913.

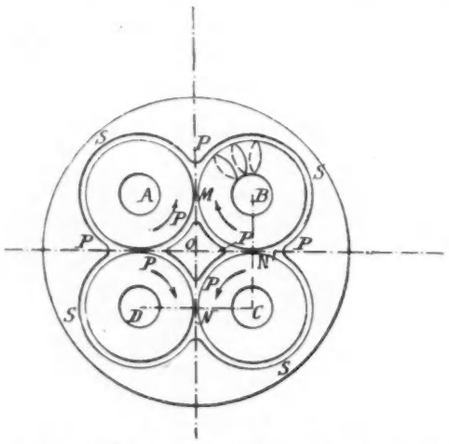


FIG. 1—DIAGRAM OF DYNAMO WITH A CENTRAL POLE

Definition of Direction of Rotation of Vectors in Alternating-Current Diagrams.—A French translation in abstract of the recent discussion in *Elek. Zeit.* by Strecker, Georges, Breisig and Wagner.—*La Lumière Elec.*, Sept. 13 and 20, 1913.

Silent Operation of Electric Machines.—S. Pontecorvo.—A translation of his German paper, noticed some time ago in the *Digest*, on the design of electric machines for quiet operation. The causes of noise are discussed together with methods of overcoming them.—*Elec. Journal*, September, 1913.

Generation, Transmission and Distribution

Electric Power Plant at Coal Mine.—R. Rinkel.—The author sketches the development of the lignite industry in the Cologne district and the part which has been played in this development by the erection of the electric power plants at the mines for selling electricity in bulk to the surrounding cities and towns. He describes especially the electric plant erected at the Fortuna mine, which has at present a capacity of 16,000 kw but is to be enlarged to 32,000 kw during this year. The lignite is conveyed directly from the mine to the boiler house. For the generation of electricity large turbo-generators of 4000 kw and 8000 kw have been installed so that the first cost of the plant is relatively low. The item of wages is also low, since automatic machinery is used wherever possible. The generating cost is below 0.5 cent per kw-hr. The largest consumer is the city of Cologne, to which three-phase energy is transmitted at 25,000 volts through cables. At the city limits this pressure is stepped down by transformers. Distribution throughout the city and sale to consumers are both in the hands of the municipality. The city has made a thirty-year contract with the mine. Details of this agreement are kept secret, but it is known that the city can buy the electricity cheaper from the mine plant than it can be generated in the municipal plant. For this reason the city has decided not to enlarge its present 16,000-kw power plant. The cost of generating electricity at the municipal plant, inclusive of distribution cost, was in 1911 0.88 cent per kw-hr., of which amount the coal cost alone was 0.485 cent, and the central-station cost 0.7 cent. It is, therefore, believed that the Fortuna Mine plant sells energy to the city at 0.6 cent to 0.75 cent per kw-hr. at the transformer substation. The Fortuna Mine power plant also has other large consumers, among them the city of Muelheim. When the electric service was operated there by the municipality itself, the output was 1,334,484 kw-hr. during the first six months of 1912. After the Fortuna Mine power plant company had taken over the supply 2,413,135 kw-hr. were sold in Muelheim in the first six months of 1913. The increase in kilowatt-hours sold was thus 80.82 per cent in one year. Meanwhile the number of customers had increased from 745 to 1305, or by 75 per cent. Energy is sold in this case on a two-rate schedule, the usual rate being 2.5 cents per kw-hr., except during certain evening hours, which are 4:30 to 10 p. m. in January, 5:30 to 10 p. m. in February, 6:15 to 10 p. m. in March, 7:30 to 10 p. m. in April, 8:15 to 10 p. m. in May and August, 6:30 to 10 p. m. in September, 5:30 to 10 p. m. in October, 5 to 10 p. m. in November, and 4:15 to 10 p. m. in December. During these specified evening hours the price charged for the first 2000 kw-hr. is 11.25 cents per kw-hr., and for consumption in excess of this, 6.25 cents per kw-hr. Meters are installed and house connections made free of charge. If a consumer does not like the double-rate schedule, he can have his electricity supplied at a straight rate of 7.5 cents per kw-hr. With large consum-

ers using 30,000 kw-hr. or more special contracts are made. Another power plant is being installed at the Rodder lignite mine. Large electrochemical works now in course of erection near Cologne will be supplied with energy from this plant.—*Elek. Zeit.*, Oct. 16, 1913.

Water-Power Plant.—E. FREYE AND O. ALBRECHT.—A continuation of their long detailed illustrated description of the Wyhlen power plant of the Rheinfelden power transmission system. Following an account of the arrangement of the generators and the switchboard the authors describe the transformer plant. There are six transformers, each rated at 2600 kva, which raise the pressure from 6800 volts to 47,000 volts.—*Elek. Zeit.*, Oct. 16, 1913.

Mississippi River Water-Power Plant.—M. NORDENSWAN AND C. W. SCHMIDT.—The first part of an illustrated description of the 300,000-hp hydroelectric plant of the Mississippi River Power Company at Keokuk, Iowa.—*Elek. Zeit.*, Oct. 16, 1913.

Fuel and Lubricants for Internal-Combustion Engines.—B. H. ARNOLD.—The great demand for gasoline as a fuel for internal-combustion engines has inflated its price to a point where the expense of operating gasoline engines of large size has become a matter of considerable moment. Lower fuel costs have been the subject of much recent investigation by corporations and engineering societies, especially along the line of improved engine design and the adoption of specifications for petroleum distillates. The author shows that the prevailing practice of specifying gasolines according to their specific gravities affords a much less accurate indication of the fuel values than specifications based on fractional distillation. Curves are included which show that, although the specific gravity of one grade of gasoline may be less by 10 or 15 per cent than that of another, the fuel of greater density may by analysis be the better. Typical specifications for gasolines for slow and medium-speed engines and for high-speed engines are given. A satisfactory economical lubricating oil should possess the qualities of wearing well and burning clean. What the viscosity of the oil should be is a matter determined by the design of the engine.—*Gen. Elec. Review*, October, 1913.

Atmospheric Disturbances.—G. CAPART.—A paper read before the Vienna Electrical Society. In the first part the author discusses those meteorological phenomena which have an influence on overhead transmission lines. In the second part the protection of lines against such disturbances is discussed and protective apparatus, especially the Giles valve, is described.—*Elek. u. Masch.* (Vienna), Sept. 14 and 21, 1913.

Traction

Overhead-Line Construction.—J. SIMY.—An illustrated article on the pantograph overhead-line construction of the Chemins de Fer du Midi.—*La Lumière Elec.*, Sept. 20, 1913.

Installations, Systems and Appliances

French Central Stations.—P. BIZET.—An illustrated article on the equipment, the tariffs used and the financial results obtained at the central stations of Rouen, Nancy and Marseilles. An interesting comparison is made between the results at Nancy and at Rouen. The capital invested in these two plants is about the same, $1,670,000, but the application of more favorable rates at Nancy has resulted in a much greater utilization of electrical energy there than in Rouen. In Nancy 9,700,000 kw-hr. were sold last year; in Rouen 3,280,000 kw-hr. were sold; and although the average price per kilowatt-hour in Nancy was half that in Rouen (4 cents compared with 8 cents), the financial results are somewhat better in Nancy. This comparison shows that through a liberal rate schedule not only are the customers better served by the central station, but also the central station itself derives better returns.—*La Lumière Elec.*, Oct. 4, 1913.

Switchboard Design.—EMIL BERN.—After a short description of the familiar vertical switchboard the author deals with the requirements which have caused the development of the bench type of board and gives a description of the elementary benchboard. This is followed by a further description of the construction and layout of several modifications designed for special conditions, with a presentation of the advantages of each.—*Gen. Elec. Review*, October, 1913.

Electric Heating and Electric Power.—P. BIZET.—The author first discusses electric heating and cooking for domestic purposes and in bakeries and then takes up the advantages of the use of electric motors with central-station energy supply instead of the installation of isolated plants.—*La Lumière Elec.*, Oct. 18, 1913.

Use of Electricity in Agriculture.—C. J. ROHRER.—An article illustrated by numerous diagrams from actual data on the question of how much electricity might be used by the average farmer. The author presents in concise tabulated form a quantity of data collected from some 130 farms supplied with electric service from transmission lines in their vicinity. Five electric companies are represented and the character of the rural service of each is analyzed in detail. From the figures given it is obvious that a purely lighting load would afford poor returns in most cases on the necessary investment, but experience goes to show that once the farmer is made acquainted with the capabilities of the electric motor he is quick to adopt it, thus providing a profitable source of revenue to the company. Of the total service supplied by these five companies, fully two-thirds is for power, the principal demand for which comes during the daytime and is thus a most desirable day-load builder.—*Gen. Elec. Review*, October, 1913.

Choke Coils.—R. EDLER.—An article on the calculation of choke coils. From experiments with a choke coil of simple construction, the author draws some conclusions, especially on the effect of the air-gap, which permit precalculation of such coils. A numerical example is given.—*Elek. u. Masch.* (Vienna), Sept. 21 and 28, 1913.

Electrophysics and Magnetism

Skin Effect.—R. SWYNGEDAUW.—The first parts of a highly mathematical article on the skin effect in cylindrical conductors, plates and rails.—*La Lumière Elec.*, Oct. 11 and 18, 1913.

Attraction of an Armature by an Electromagnet.—J. BETHENOD.—A. Vaschy has developed the following formula for the attraction F of an electromagnet excited by a current i upon a soft-iron armature at the distance x, if l is the coefficient of self-induction of the electromagnet for the distance x:

$$F = \frac{1}{2} i^2 \frac{d\,l}{d\,x}$$

The present author discusses the more general instance in which the electromagnet is excited by two or more independent currents. In this case the general formula becomes

$$F = \frac{1}{2} \Sigma I_k^2 \frac{d\,L_k}{d\,x} + \Sigma I_k I_j \frac{d\,M_{kj}}{d\,x}$$

where I, I are the exciting currents, L the coefficient of self-inductance and M the coefficient of mutual inductance. The application of this formula to the theory of circuit-breakers is discussed.—*La Lumière Elec.*, Oct. 18, 1913.

Electrochemistry and Batteries

Brush Discharge.—A. VOSMAER.—A long article on the author's extended researches on brush discharge, with special reference to the generation of ozone. In the first part the author deals with the brush discharge through air without the use of solid dielectrics, in the second part with the use of solid dielectrics.—*Metall. and Chem. Eng'ing*, November, 1913.

Electric Furnaces.—W. McA. Johnson and G. N. Sieger.—A continuation of their fully illustrated article on electric furnaces and their design, characteristics and commercial applications. The authors deal with the electric furnace, structurally considered, the use of refractories, methods of laying an arch, methods of water-cooling, and the heat insulation of furnaces.—*Metall. and Chem. Eng'ing,* November, 1913.

Electric Zinc Smelting.—An illustrated article by F. Louvrier describing his electric zinc furnace, in which he claims to have succeeded in condensing zinc in liquid form with only very little production of blue powder. A second article, by F. L. Clerc, discusses the different effects which must be taken into account in condensing the zinc gas to liquid in the presence of inert gas.—*Metall. and Chem. Eng'ing,* November, 1913.

Units, Measurements and Instruments

Use of the Synchronous Commutator in Alternating-Current Measurements.—Frederick Bedell.—A paper in which the author describes the uses of the synchronous commutator for the following measurements: Determination of average value of alternating electromotive force and current; use as zero instrument; determination of form factor of alternating current or voltage; determination of wave-form and maximum value of alternating magnetic flux. The author then takes up the determination of wave-forms and maximum values of alternating currents and electromotive forces by means of three methods, namely, the air transformer method, the condenser current method and the condenser discharge method. He finally deals with the determination of phase difference. The article is illustrated by numerous diagrams.—*Journal Franklin Inst.,* October, 1913.

Quantitative Spectrum Analysis.—G. A. Shook.—In the third article of his serial on this subject the author deals with industrial applications and describes the calibration of a Koenig-Martens polarization spectro-photometer and the determination of concentration for colorless solutions.—*Metall. and Chem. Eng'ing,* November, 1913.

Sea-Water Temperature Annunciator.—A note on a recent British patent (No. 9695, 1913) of A. McNab. The indicator is placed in the hull of the vessel and subjected to a continuous flow of sea water. The indicator itself consists of a thermometer containing conducting and non-conducting liquids, while a series of insulated conducting studs is provided, so that a test lever, whose position is determined by the height of the liquid columns (in turn controlled by the temperature of the water), closes the circuit through the conducting liquid and an incomplete alarm circuit, part of which is formed by the insulated studs in the thermometer.—London *Elec. Eng'ing,* Oct. 16, 1913.

Telegraphy, Telephony and Signals

Telegraph Experiment Station.—K. Strecker.—The conclusion of his illustrated description of the German telegraph experiment station in Berlin. Details are given of the system of current supply to the laboratories and of their equipment for investigations in telegraphy, wireless telegraphy, testing of materials, photometry, etc.—*Elek. Zeit.,* Oct. 16, 1913.

Sine-Wave Transmission in Submarine Cables.—H. W. Malcolm.—A continuation of his long mathematical article illustrated by diagrams. The author discusses the influence of apparatus, the effect of a single oscillation and of a semi-oscillation, battery signal, sending-end phenomena, and distress of the cable.—London *Electrician,* Oct. 17, 1913.

Pupin Coils.—A note on a recent British patent (No. 12,565, 1913) of Siemens & Halske. To avoid cross-talk and other effects on physical phantom circuit combinations, Pupin coils are made with the different coils divided into concentric sections. There is a different number of winding sections belonging to the separate coils in every plane of the winding, and an approximately uniform field distribution in every plane of the winding.—London *Elec. Eng'ing,* Oct. 16, 1913.

Simultaneous Telephony and Telegraphy.—H. S. Warren.—An article on the joint use of wires for telegraph and telephone service discussing simplex and composite combinations and phantom circuits.—*Elec. Journal,* September, 1913.

Miscellaneous

Electrical Congress in Moscow.—Some notes on the proceedings of the Moscow Electrical Congress. Messrs. Tschernischoff and Goreff read a paper on "The Comparison of the Present Methods of Measuring Tensions and Forces in High-Voltage Lines." Goreff presented a report on direct-current and polyphase systems with several conductors, Kamensky one on the choice of systems and of voltages in city networks, and Veretschaguine one on the relative status of the different systems on electric wiring and cable networks. For cities with small population the overhead network is recommended, for cities with medium population a mixed system employing both overhead wires and cables, and for very densely populated cities an underground cable system. Pavlitsky read a paper on the electrification of city water supplies, recommending their connection with central stations and the employment of motors and electrically driven pumps. Belateloff read a paper on the development of Moscow as a telephonic center for interurban connections, Polivanoff discussed the question of a rapid-transit electric railroad in Moscow and emphasized that it would not be detrimental to the tramway system since they could exist side by side. Chapirer discussed accidents due to electricity and Steinhaus legislation regarding an electric unit and governmental control of measuring apparatus and instruments in different countries.—*La Lumière Elec.,* Oct. 4, 1913.

Influence of the Presence of Gas Upon the Inflammability of Coal-Dust in Air.—W. M. Thornton.—An abstract of a paper read before Section B of the British association giving an account of experiments made to find the least current which will ignite a mixture of dust and gas, the percentage of gas in this case being kept constant in the successive trials while the circuit is broken with different

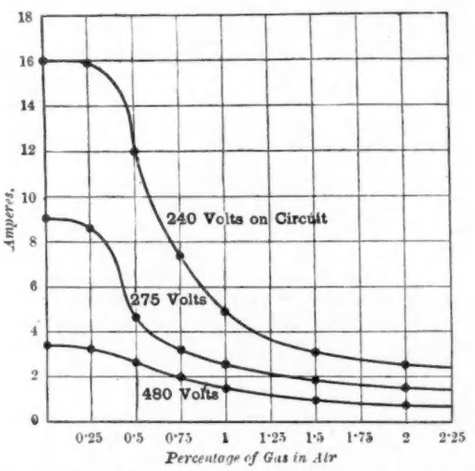


FIG. 2—CURVES SHOWING CURRENT NECESSARY TO IGNITE NEWCASTLE COAL-GAS

currents flowing. The explosion vessel was closed by a flap valve at one side, which prevented air entering during the mixing but yielded to pressure from within. The results obtained with Newcastle coal-gas are given in Fig. 2. There is at each of the three voltages a definite relation between the least igniting current and the percentage of gas. The height of each curve is the least current

which at the given voltage and percentage of gas causes a full ignition, and it is seen from the figure that 0.25 per cent of gas has little or no effect in forwarding ignition, though with more than this there is a rapid increase in sensitiveness. The same result is obtained with pit gas. In Fig. 3 the results of the experiments are plotted with the least igniting current as ordinates and volts as abscissas.

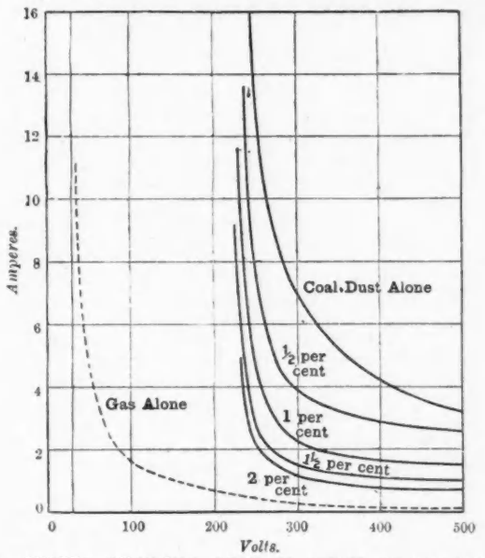


FIG. 3—CURVES SHOWING RESULTS WITH LEAST IGNITING CURRENT

There is a potential (about 200 volts in this case) below which ignition of clouds of dust, even with 2 per cent of gas present, is exceedingly difficult. The nest of curves is symmetrical about a line drawn through this point on the base and through the nearest point on the "no-gas" curve. This would, therefore, appear to be about the highest voltage which may be regarded as relatively safe in a gassy and dusty atmosphere where the percentage of gas is not above 2 and where very large open flashes are not possible. Although the gas has so great an influence in forwarding the combustion, it is clear that the dust is still the dominant factor in the explosions. The gas must be regarded as the auxiliary, not as the principal factor, in the ignition of the combined mixture of gas and dust at low percentages.—London *Electrician*, Sept. 26, 1913.

Book Reviews

ELECTRICAL INSTRUMENTS AND TESTING. By Norman H. Schneider. Including Testing Telegraph Wires and Cables and Locating Faults, by Besse Hargrave. Revised and enlarged edition. New York: Spon & Chamberlain. 256 pages, 133 illus. Price, $1.

A very practical elementary textbook on electrical testing and testing instruments, for the use of electrical operators in the engine room, telephone exchange, telegraph office or power plant. The underlying principles are explained in very simple terms, and the mathematical formulas employed are of the fewest and simplest. The ordinary electrical testing instruments, such as keys, galvanometers, Wheatstone bridges, voltmeters, etc., are fully illustrated and explained. The chapter on "testing with the voltmeter" will be found to be a particularly practical presentation of its subject. The book as a whole will be useful not only to students of elementary electrical engineering but also to operators, wiremen and artisans. It will appeal as well to the large class of non-electrically trained electrical workers who welcome a clear and easily understood textbook on the principles of their art.

RAILWAY SIGNAL ENGINEERING (MECHANICAL). By Leonard P. Lewis. New York: D. Van Nostrand Company. 358 pages, 250 illus. Price, $3.50.

This book is a carefully written, well illustrated and rather detailed description of the mechanical (manually operated) railway signals now in use in England. It is complete enough to give one who is not informed on railway signal work a good idea of British practice and apparatus. The requirements of the Board of Trade, the different classes of signals, schemes of signaling and methods of operating trains are described. The explanation of interlocking apparatus and the use of tables and diagrams are especially clear and interesting.

COURS DE PHYSIQUE GÉNÉRALE. Vol. II. By H. Ollivier. Paper, 296 pages, 112 illus. Paris: Librairie Scientifique, A. Hermann et Fils. Price, 10 francs.

This is the second volume of a textbook on mathematical physics. This volume deals with thermodynamics and radiant energy. The treatment is very condensed, mathematical, thorough, and intended for advanced students. The book is divided into two sections, dealing respectively with thermodynamics and radiation. The first section comprises eleven chapters relating to the following subjects: Introductory, first principle of thermodynamics, applications of the first principle, second principle of thermodynamics, available energy, general deductions from the first two principles, perfect gases, uniform fluids, solids, certain single-variant systems, other applications of thermodynamics, kinetic theory of gases. The second section comprises thirteeen chapters on the following subjects: General properties of radiation, Kirchhoff's law of emission and absorption, black-body radiation, other types of radiation, incandescence, radiation pressure, relations between emission, absorption and dispersion, luminescence, Zeemann's phenomenon, the effect of magnetic fields, solar radiation, stellar radiation, gaseous radiation. The book is logically arranged and carefully prepared.

ENGINEERING AS A PROFESSION. Scope, Training and Opportunities for Advancement. By A. P. M. Fleming and R. W. Bailey. 288 pages. Price, 2s. 6d. London: John Long, Ltd.

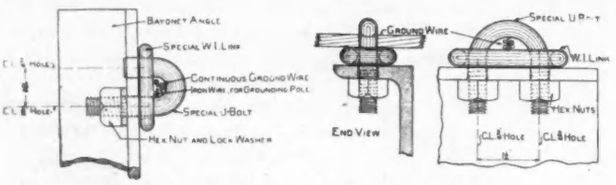
Although a book published in England for the avowed purpose of assisting the youth, parent or guardian in the choice of a profession is necessarily of special interest to Englishmen, yet there are many, not only in the British colonies but also in America, to whom the book may be of the greatest value. The education and training of young men taking up engineering in the British universities and colleges is generally recognized as being sound and thorough, especially in the matter of civil engineering, and a very large percentage of young men attending these schools are from the British colonies and South America. To such this book will be almost invaluable if it is carefuly studied before deciding upon the steps to be taken after landing in England. The ground covered includes lists of the universities and colleges, with full particulars as to fees and approximate cost of living; comparison of the engineering profession with other professions; advice as to the course to pursue in order to obtain the requisite training, whether the means at the disposal of the student are ample or modest, and, finally, the possibilities in the matter of salaries and prospects of advancement after the term of training is complete. In one chapter a comparison is made between the English, German and American systems of training, and much useful advice and information are given for the guidance of young engineers to whom England and British institutions are little known and strange. The book undoubtedly meets a demand, and it may be strongly recommended to those in need of such information as it purposes to give.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Ground-Wire Clamp

The Belcher ground-wire clamp is a device for fastening continuous overhead ground wires to the supporting bayonet, pole or transmission-line tower. It is designed to take the place of special malleable castings, bolts and plates heretofore required for the purpose. In Fig. 1 is shown the "J" type, suitable for wood, concrete or steel pole lines

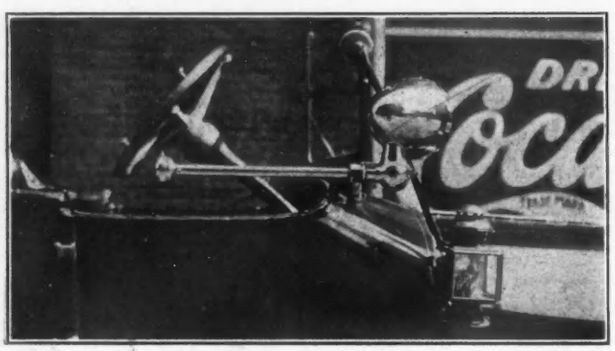


FIGS. 1 AND 2—GROUND-WIRE CLAMPS

with spans up to 200 ft. There is only one nut, and it will be favored by linemen on account of the ease of its erection. The "U" clamp, shown in Fig. 2, is used with transmission towers or steel poles, two usually being required for each ground wire. At turns in the line a thimble is used which acts as a shackle. These clamps are manufactured by Hubbard & Company, Pittsburgh, Pa.

Revolving Electric Lamp for Motor Cars

To meet the increasing requirements of auxiliary lighting on automobiles the Herrick Aiken Company, Inc., Lawrence, Mass., is placing on the market a special rotating lamp which permits the projection of a beam of light at any vertical or horizontal angle. The lamp rotates in two planes at right angles to each other and, as shown in the accompanying illustration, embodies a parabolic reflector at the ends of rods attached to the car body and easily reached by the chauffeur. The lamp is controlled from a



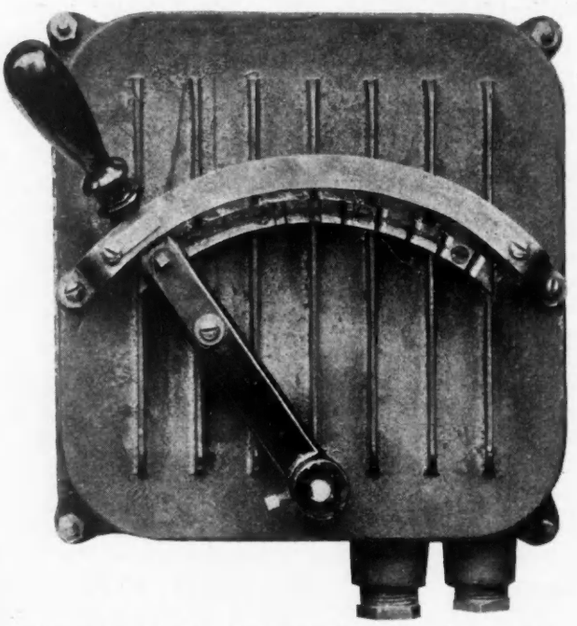
ROTATING LAMP FOR MOTOR CARS

hand-hold which contains a starting and cut-out switch just behind the steering wheel, miter gears being used to give the necessary turning. All the wiring is concealed, and in the usual equipment a 24-cp, 6-volt lamp is used, which can be operated from any source of electrical supply such as dry cells, storage batteries or the automobile lighting generator. These revolving lamps are built for both motor-boat and vehicle service, and a test installation has been driven 25,000 miles without developing any operating troubles. For "picking up" highway signs on country roads, lighting curbings and steps, or investigating machinery, this equipment gives another illustration of the convenience of electricity in motoring and allied activities.

Water-Tight Controller for Rock Drill

The accompanying illustration shows a Ward-Leonard waterproof controller for operation with an electric rock drill. The requirements for this service are unusually severe, for the controller must be capable of operating continuously at any point of its range. It must be strong, substantial and rugged in every part and must be thoroughly water-tight.

The resistor element in this controller is enameled on the inside of the cast-iron inclosing case, and the spindle



WATERPROOF CONTROLLER FOR ELECTRIC ROCK DRILL

which drives the operating contact enters the controller through a stuffing-box. The lead wires are provided with similar boxes. The controller is arranged with an open-circuit paint, a suitable magnetic-blowout device being incorporated in the box. This makes it possible to use the controller both as a switch and a speed regulator.

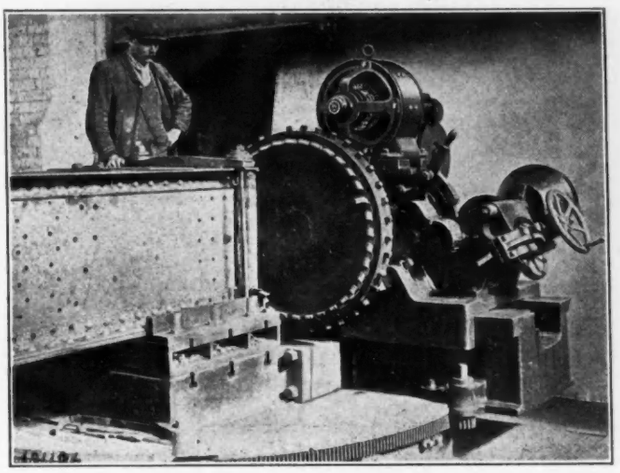
In electric drills of this kind the drill is started at about quarter speed and kept running at approximately this rate until it has made a shallow hole in the rock. The speed is then increased slightly and the hole deepened, until when the drill has worked its way down 3 in. or 4 in. into the rock the full current is turned on and the drill runs at full speed.

After continuous service under severe test conditions the controller shown was allowed to remain under 4 ft. of water for five days and on being taken out was found to operate perfectly when again put into service. The con-

troller has a notched rack which retains the operating handle in any particular position. This is, of course, very necessary, as the controller is usually mounted on one leg of the drill tripod, and is thus subjected to tremendous vibration.

Motor-Driven Rotary Planer

The accompanying illustration shows a form of planer for very large work, such as facing the ends of columns,



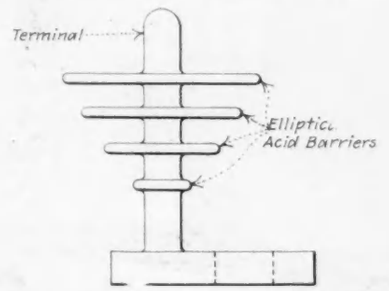
ROTARY PLANER WITH MOTOR DRIVE

cast-iron bedplates, stringers, etc., and machining engine frames and other heavy castings. The cutting tools are arranged in a circle and rotate when in operation.

The machine can handle work 40 in. wide and 6 ft. long. It is mounted on a circular base on which it can be turned, thus increasing its range of operation. The planer is manufactured by the Newton Machine Tool Works, Philadelphia, Pa., and is driven by a Westinghouse motor.

Non-Corrosive Terminal for Small Storage Batteries

The Philadelphia Storage Battery Company, Philadelphia, Pa., has recently added a non-corrosive terminal to the small storage batteries which it makes for starting and lighting automobiles and for general ignition purposes. As shown in the accompanying sketch, the main stem of the terminal is cast with four elliptical flanges located at regu-

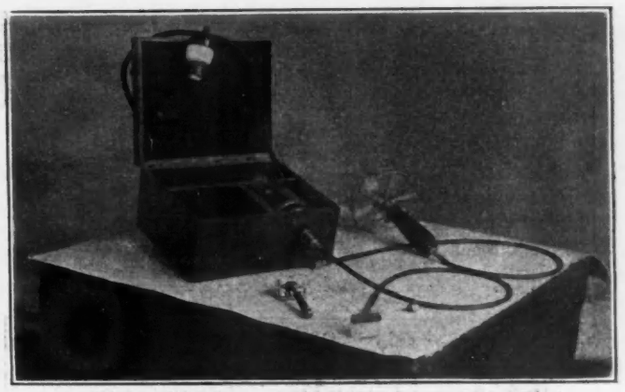


TERMINAL FOR SMALL STORAGE BATTERIES

lar intervals along its length, the largest being at the top. When the terminal is placed in the finished cell these flanges are embedded in the composition used to seal the jar. Thus the path of the acid in reaching the external terminal is made long and tortuous. The manufacturer claims that such a terminal will last during the full life of the battery, allowing no acid to escape from the cell by this route.

An Electric Razor

An electric razor has been patented and will be placed on the market shortly by the Vibrating Electric Razor Company, 937 East Fifty-fourth Street, Chicago, Ill. It consists of a safety razor connected to a motor by means of a flexible shaft, the blade being actuated in such a way as to cut the beard by impact or blows. The blades, therefore, do not need to be so sharp as in hand-shaving. No soap is necessary, wetting of the skin being sufficient, and a clean shave can be accomplished, it is declared, in a very short

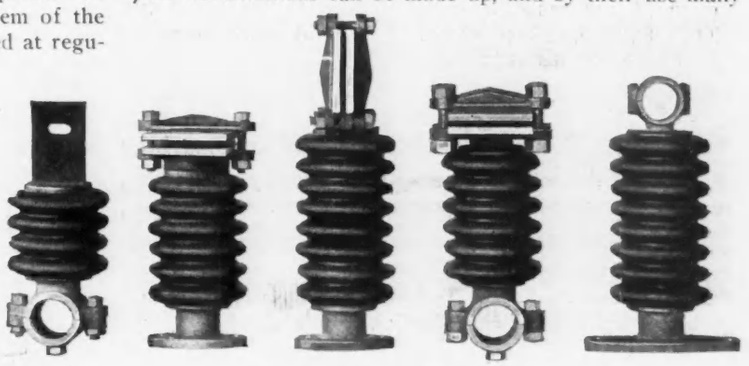


ELECTRIC RAZOR

time. The after-effects are described as being those following a mild massage. A plug is provided for attaching the razor to any lamp socket. In the accompanying illustration is shown a combination razor set with a small electric fan which is useful in drying women's hair. The whole is inclosed in a neat box.

High-Tension Busbar Supports

A new "unit-type" high-tension support for interior station wiring, busbar work, compartment service, etc., is illustrated herewith. The fundamental unit is made up of wet-process glazed brown porcelain and contains a recess into which is "key-cemented" a threaded malleable-iron thimble. With such a design any desired fitting can be secured to the insulator unit. A few of the various commercial forms are shown in the accompanying illustrations. With the standard fittings commercially available, over 7000 combinations can be made up, and by their use many



BUSBAR SUPPORTS

different problems encountered in laying out busbar compartments, etc., can easily be solved.

A distinct advantage of this new type is the decided gain in space possible when building compartments owing to the fact that there are no overhanging projections cutting down the creepage distance. The compartments also can be made smaller than necessary with the older forms, and this in turn effects a large saving as compartment work is

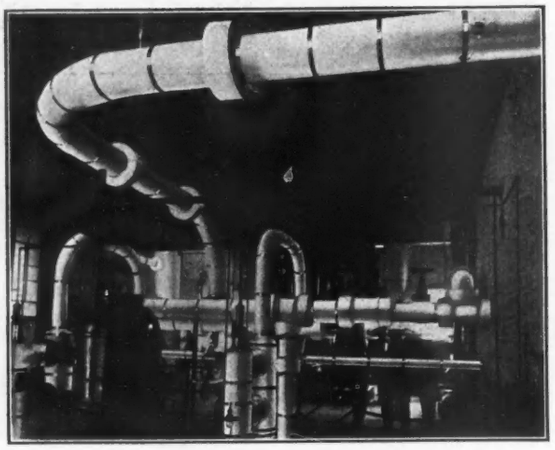
relatively expensive. The characteristics of the "unit-type" support are well illustrated by the following tabulation showing the high factor of safety secured:

Normal rated voltage, 6,600 volts; flashover test voltage, 30,000 volts
Normal rated voltage, 13,200 volts; flashover test voltage, 54,000 volts
Normal rated voltage, 22,000 volts; flashover test voltage, 75,000 volts

This busbar insulator is manufactured by the Delta-Star Electric Ccompany, Chicago, Ill.

Combination Asbesto-Sponge Pipe Lagging

The H. W. Johns Manville Company, New York City, has recently added another combination-asbestos product, known as "asbesto-sponge felted pipe and boiler covering," to its line of heat-resisting materials. Recent tests made by Prof. C. L. Norton, of the Massachusetts Institute of Technology, are said to have shown that the yearly cost of maintaining 100 sq. ft. of steam pipe at a pressure of 100 lb. gage is $225 for bare pipe, $35.90 for pipe carrying molded insulation 1 in. thick, and $25.40 for the asbesto-sponge insulation. The new product is made of many lay-



STEAM PIPES WITH ASBESTO-SPONGE COVERING

ers of thin felt composed of asbestos fiber and finely ground sponge, and it is said to be tough and flexible, so that vibration, moisture, heat or rough usage will not cause it to lose its insulating efficiency. It is fireproof and can be removed and replaced many times without deterioration. The illustration herewith shows a set of steam pipes covered with this insulating material.

Electric Drills with Ball and Roller Bearings

Two additions have recently been made by the Independent Pneumatic Tool Company, Chicago, to its line of motor-driven drills. The two principal features of these new drills are the provision of universal motors for operation on either direct or alternating current and the use of bearings which are a combination of the ball and roller types. The motors are designed for 110-volt and 220-volt operation and for any commercial frequency.

Maximum Size Hole, In.		Reaming Capacity, In.	Full Load Speed, R.P.M.	Weight, Lb.
Steel	Wood			
0.25	0.375	0.1875	1500	6
0.3125	0.5	0.25	750	7

The holes shown in the aluminum case provide sufficient ventilation for the motor and when it is desirable to clean the commutator the removal of one nut makes the segments easily accessible. Although both of these drills are furnished with 10-ft. lengths of flexible conductor, an attachment is provided which makes it possible to use the drill with cords of different lengths. The accompanying table gives a few mechanical details concerning the two types of drills, which are called Thor universal drills.

MOTOR-DRIVEN DRILL

Electric-Iron Cord Holder

An electric-iron cord holder, designed to meet a long-felt want in the laundry, has been put on the market by the Paragon Electric Company, 9 Clinton Street, Chicago, Ill. Cords on electric irons often give trouble by getting in the way, becoming tangled with the clothes and being wetted by dragging over moist garments, all resulting in unnecessary injury and wear.

The holder herewith illustrated keeps the cord out of the way and has enough tension to prevent the cord from sagging, without producing a drag on the motion of the iron. The holder is fastened to the right-hand side of the ironing-board or table by means of a clamp, and the cord is looped over a rubber-covered "V." It can be adjusted in such a way that, with the iron directly under the arm, the cord will run straight up to the "V." If the operator is left-handed and wishes to use the holder on the left-hand side of the board the mere change of two screws will permit the arm to be attached on the other side of the clamp.

CORD HOLDER FOR ELECTRIC IRON

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

A 35,000,000-Kw-Hour Customer.—One of the largest customers of the Commonwealth Edison Company of Chicago has been acquired comparatively recently. This is the Universal Portland Cement Company, which takes 5000 kw, measured maximum, at 80 per cent load-factor. This customer is supplied on an off-peak basis, and its requirements amount to about 35,000,000 kw-hr. a year.

Refrigerating Machine Sales Fall Off with the Approach of Cold Weather.—Since the last report, sales of refrigerating machines by the York Manufacturing Company have fallen off over 50 per cent, owing to the cold weather dullness in that line. The aggregate sales during October amounted to only 318 tons capacity, and the largest single machine was one of 100 tons rating, sold to the Ebner Ice & Cold Storage Company, of Vincennes, Ind.

Federal Control and Conservation of Coal Resources.—In testimony given before the Ohio Coal Mining Commission recently, Prof. Edward Orton, Jr., of the Ohio State University, claimed that only under federal control could conservation principles be applied to the coal-mining industry. It was admitted that the cost of the coal under these conditions would be greater, but it was urged that such control would provide for the mining of coal in a manner to prevent waste, a thing which it is impossible to do under the present competitive conditions.

Tour of Inspection of Export Shipping Facilities at New York.—In view of the growing export business in this country, of which movement the electrical industry is in the van, a tour has been arranged, under the auspices of the National Association of Manufacturers, to inspect the facilities at hand at the port of New York for efficiently handling goods for foreign shipment. The tour will be made on Nov. 11 and 12, and on the first day it will be devoted to inspection of the docks and transfer facilities along the east and west waterfronts of Manhattan. At a luncheon to be given at the Machinery Club on Nov. 11 there will be given short talks by experts on packing for export, freight-handling and refrigerating methods. On the second day of the tour attention will be given to the docking facilities along the New Jersey and the Brooklyn waterfronts.

Kerr Turbines Sold for Various Services.—The Kerr Turbine Company, of Wellsville, N. Y., has recently obtained an order from the Edgar Thompson Steel Company, of Pittsburgh, Pa., for two 1000-hp turbine units for driving the water-supply pumps at the works of the latter concern. Among the other companies which have recently placed orders for Kerr turbines are the Duquesne Light Company, of Pittsburgh, Pa., which is purchasing one unit of 250 hp, eight of 200 hp and eight of 22 hp capacity; the New Britain (Conn.) Gas Light Company, the John Simmons Company, the Citizens' Light, Heat & Power Company, of Johnstown, Pa., and Swift & Company, of Chicago. Turbo-generator equipment totaling 700 hp has been ordered by the Citizens' Electric Company, of Williamsport, Pa., the J. B. Jenkins Coal & Coke Company, of Elkins, W. Va., and the North Carolina Teachers' Training School, at Greenville, N. C.

Westinghouse Electric Company Busy.—The business of the Westinghouse Electric & Manufacturing Company during October was reported to be equal to that during August and in excess of that during September. For the first half of the company's fiscal year, or from April 1 to Sept. 30, it is estimated to have earned over 6 per cent on its common stock, but this rate of earnings is not expected to continue for the next six months. Enough orders are said to be now on the company's books to keep it working for the next five months if no others were received. During the last couple of months the company has not been a heavy purchaser of copper, and it is possible that extensive buying of that metal may be done shortly, if the present prices continue in effect. In connection with some financing operations carried on in the past, a suit has been brought by the First-Second National Bank of Pittsburgh against the Chase National Bank to determine the right of the Westinghouse company to set off its deposit in an insolvent bank against that bank's participation in a loan, which participation was gained by the agreement that a deposit should be made with the bank.

Difference of Opinion Regarding the Copper-Wire Business.—Some difference of opinion has been observed concerning the present business conditions in the wire industry. A manufacturer of bare wire visited within the past week made no secret of the fact that his business has fallen off 25 per cent from normal, and, while he admitted that the cause of the slump in buying is not entirely clear to him, he seemed to look upon it as a healthy condition which would eventually react to produce a gradually increased demand. He thought that with the present unsettled condition of the country, financially and politically, it is a good thing that business has fallen off a little. On the other hand, a manufacturer of high-grade insulated wire interviewed very recently was in a particularly optimistic frame of mind and stated that his business was continuing exceptionally good. This apparent paradox may be accounted for, at least in part, by the fact that the bare wire is very largely used in transmission-line extension work, and, owing to the tightness in the money market for some time past, there has been little activity in that field, through inability to finance extensions on favorable terms. The insulated wire, on the other hand, is used to a large extent on small work and in constructing machinery, and the natural tendency is for an increase in this kind of work during periods when the big operations are necessarily suspended.

Electric Locomotives Ordered for the New York Central.—The New York Central & Hudson River Railroad Company has recently ordered six additional powerful electric passenger locomotives from the General Electric Company for terminal service out of New York City. Early in the year ten electric locomotives of the most powerful type ever built were ordered from this company for the same service. These engines weigh 100 tons each and are each equipped with eight GE-89 bipolar, gearless motors, all the weight of the machine being carried on motor-driven axles. While the new machines are of the same type and construction, they are somewhat heavier, weighing 110 tons, and owing to recent advancement in locomotive design have materially increased capacity. The increase in weight in these machines is accounted for mainly by the greater amount of material in the motors, which are of larger capacity. The speed and torque characteristics of the locomotives have been practically the same as those of the former ten machines, but the new locomotives are capable of hauling approximately 40 per cent greater tonnage in continuous service. The previous ten 100-ton locomotives have a capacity for developing 1460 hp continuously, 2000 hp for one hour and can develop as high as 5000 hp for short periods. The six new electric engines will develop 2000 hp continuously, or 2600 hp for one hour. The motors are electrically connected permanently in parallel in pairs, and the pairs can be connected in three combinations, viz., series, series-parallel and parallel. They are insulated for 1200 volts, so that if at any future time it should be desired to operate the locomotive on this voltage, the pairs of motors could be changed from parallel to series connections and the same speeds and control combinations obtained as at present on 600 volts. The new locomotives are now under construction in the works of the General Electric Company, at Schenectady, N. Y., and will be placed in operation as soon as completed.

Fertilizer Plant to Install Electrical Equipment.—The General Electric Company has received an order from the Export Phosphate Company for extensive electrical equipment for its plant at Boston, Mass. The apparatus purchased includes two 400-kva, 2300-volt alternators, eight motors, ranging from 10 hp to 375 hp and aggregating 1055 hp, together with switchboards and auxiliaries.

Copper Market Stagnant.—The American copper market is at present very dull. Purchases are reported to be covering only the absolute necessities of consumers, and buying for future delivery is practically at a standstill. Several factors probably combine to produce this state. Prices are rather high, and it is not so long since fears were entertained of a large increase in prices, due to the decrease in production and to a period of continued large demand. It is possible that this impending crisis forced consumers to curtail their purchases. Also it is reported that one of the big electrical manufacturing companies has on hand a supply of copper sufficient to care for its needs for the next six months, if necessary, so that it can afford to hold up present purchases. No doubt, many other large copper consumers took advantage of the low prices during the past summer to accumulate reserve stocks and are now in a position to decrease their purchases with safety. The copper situation abroad is reported to be about the same as it is here, possibly a little better, so there may be factors entering into the local depression which are not of strictly local origin.

General Business Conditions in Electrical and Allied Fields.—Talking with the New York representative of a firm that does a country-wide business in auxiliary equipment for steam power plants, both for public utility and for private service, the fact developed that, while the business of this company has been about normal of late, its ratio between estimates given and contracts received has been unusually high. This concern, therefore, inclines to the belief that, in general, business in those lines is not particularly brisk at present and is, in fact, getting poorer rather than better. It has made preparations for decreasing its production if the present slump continues and begins to affect its own business. If the opinion of this company represents the prevailing sentiment concerning the present trend of events, there has developed so far no radically pessimistic feeling, and any slump that has started has been very gradual. There have been a number of disturbing influences during the past quarter, any one of which might be expected normally to exercise a depressing influence on business conditions, and that their combined effect should fail to be felt is hardly likely. At the same time, the fact that the slump has not been more marked would seem to be a matter for congratulation and apparently indicates that the fundamental conditions are very favorable. It might not be an inaccurate prediction that an early settlement of the currency issue and a satisfactory solution of the Mexican problem would bring on a period of prosperity, in spite of the lowering of tariff rates.

NEW YORK METAL MARKET PRICES

	Oct. 28 Bid.	Oct. 28 Asked.	Nov. 3 Bid.	Nov. 3 Asked.
Copper:				
Standard, spot*	15.87½	.....	.....	.....
	Selling Prices		Selling Prices	
	£ s d		£ s d	
London, standard, spot*	74 15 0		71 10 0	
Prime Lake	16.87½	to 17.00	16.87½	.....
Electrolytic	16.62½	to 16.75	16.37½	.....
Casting	16.35	to 16.45	16.00	.....
Copper wire base	17.50	to 17.75	17.50	to 17.75
Lead	4.35		4.35	
Nickel	40.00	to 45.00	40.00	to 45.00
Sheet zinc, f.o.b. smelter	7.50		7.50	
Spelter, spot	5.40	to 5.45	5.37½	.....
Tin, spot	39.75	to 40.00	39.70	to 40.00
Aluminum:				
Prompt delivery	19.75	to 20.00	19.75	.....
Future	19.75	to 20.00	19.50	to 19.62½

*OLD METALS

Heavy copper and wire	15.00	15.00
Brass, heavy	9.75	9.75
Brass, light	8.50	8.50
Lead, heavy	4.20	4.20
Zinc, scrap	4.37½	4.37½

*COPPER EXPORTS

Total tons to Nov. 3	29,007

*From daily transactions on the New York Metal Exchange.

Corporate and Financial

Minnesota Gas & Electric Company Bond Issue.—An issue of $325,000 first-mortgage sinking-fund 6 per cent gold bonds of the Minnesota Gas & Electric Company, of Albert Lea, Minn., is offered through P. W. Brooks & Company, New York, at par and interest. The bonds are due on Aug. 1, 1933, but are redeemable on or after Aug. 1, 1918, at 103 and interest. A new electric plant was placed in operation by the company in September, bringing its generating capacity up to 1350 kw.

Chapin Estate Still to Control Indiana & Michigan Electric Company.—Charles A. Chapin, of Chicago, who died on Oct. 22, was the principal owner of the stock of the Indiana & Michigan Electric Company, of South Bend, Ind., which operates a string of hydroelectric plants in southern Michigan and northern Indiana. By the terms of his will, disposing of an estate valued at $4,651,000, his widow and seven children are all named as trustees of the estate. It is provided that any sale, transfer or conveyance of any part of the trust estate, including stock in the electric company, cannot be made except by the consent of all the trustees.

United Wireless Telegraph Company Matters.—In connection with the acquisition, in 1912, of the assets and patents of the United Wireless Telegraph Company by the Marconi Wireless Telegraph Company of America, the Wireless Liquidating Company was formed as an intermediary. Stockholders of that company will vote on Nov. 17 on the proposal to dissolve it and to instruct its directors to distribute its holdings of stock of the Marconi company. In case this action is taken and some stockholders shall become entitled to receive fractions of shares, it is planned to transfer the shares representing the fractional interests to a trustee who shall issue scrip, exchangeable for full shares. This will be the last move in the consolidation of the two operating companies.

Merger of Georgia Utility Companies.—Control of the Georgia Public Service Corporation has recently passed into the hands of the Central Georgia Power Company, and the properties of the former concern will hereafter be operated in connection with those of the latter. The Georgia Public Service Corporation was organized in May, 1912, by W. J. Massey, formerly president of the Central Georgia Power Company, and until its acquisition by that concern was in active competition with one of the latter's subsidiaries, the Macon Railway & Light Company, for the electric-lighting business of Macon, Ga., and vicinity. During the rate war between these two concerns the price of energy fell to a comparatively low figure, and, now that a consolidation has been effected, an application is to be made to the Georgia Railroad Commission for approval of a raise in rates for lighting service.

United States Light & Heating Company's Annual Report.—The annual report of the United States Light & Heating Company was issued to the stockholders on Oct. 31, over the name of W. S. Crandall, treasurer. Income from sales during the fiscal year ended June 30 last amounted to $3,318,585, and net earnings, after deducting manufacturing costs, selling expenses and overhead charges, came to $346,930. The total assets of the company were given as $16,686,137, of which $13,701,375 was the value assigned to the item of patents and good will. During the year 1912-'13 the company's manufacturing plant at Niagara Falls, N. Y., was extended, providing about 100 per cent increased capacity, which was rendered necessary by the increased business in electric starting and lighting equipment for automobiles. In this branch of the company's business, according to the report, all expiring contracts were renewed and several new contracts were received, while both the railway-car-lighting and the storage-battery branches were reported to have done a good business. The report touched briefly upon the period between July 1 and Nov. 1, 1913, stating that during this time a substantial increase in both gross and net earnings has been realized over figures for the same period in 1912. The company is making an endeavor at the present time to reach the European market, and one large English automobile manufacturer has contracted for electrical ac-

cessory equipment of its make. A statement by J. A. Smith, president of the company, on July 23 gave fuller details concerning the extraordinary expenses of the last fiscal year, together with a brief explanation of the passing of the semi-annual preferred dividend, payable in July. Recently there has developed some dissatisfaction among the minority stockholders of the company, the claim being made that they have not been kept informed of the company's policies and movements, and that action prejudicial to their interests has been taken by the officers of the company. It is not known just how generally this feeling is entertained, but it is rumored that an official reply to the charges will appear shortly.

Pennsylvania Utilities Company Mortgage.—In the Oct. 18 issue of the *Electrical World* note was made of the proposed merging of the Eastern Pennsylvania Power Company and the Pennsylvania Utilities Company. Announcement is now made that this plan has been approved by the stockholders of both concerns and that, following the completion of the legal steps necessary to the consolidation, the directors of the new company, known also as the Pennsylvania Utilities Company, have formulated a plan for a large bond issue by that concern. It is reported that a part of the proceeds of this issue will be used for canceling the debts of the old companies and that the remainder will be held for future extensions and repairs. A meeting has been called for Dec. 30 at which the plan will be submitted for the stockholders' approval. The officers of the new company are: C. M. Phil, president; A. D. Lord, vice-president; F. B. Shannon, treasurer, and A. B. Cheadle, secretary.

Public-Utility Bonds as Investments.—Some interesting facts were brought out by Mr. John E. Oldham, of Merrill, Oldham & Company, Boston, in a paper entitled "The Place of Public-Utility Bonds in the Investment Market," read at the recent Chicago convention of the Investment Bankers' Association of America. Public-utility bonds are considered to mean the bonds of corporations which furnish light, power, transportation or telephone service. Mr. Oldham gave instances to show that while municipal and railroad bonds have depreciated somewhat in value in the last ten years, public-utility bonds have generally appreciated in value. A computation was made by the author to show the comparative returns from the three classes of bonds between 1901 and 1912. Representative public-utility, municipal and railroad issues were selected, and every effort was made to make a fair investigation. It was shown that the purchaser of $1,500,000 of public-utility bonds would have received an income on his total investment from date of purchase to July 1, 1912, of $487,500 and a gain in market value of $27,377, or a total of $514,877. From the municipal bonds the income was $326,551 and the loss due to depreciation $106,989, leaving a net return of $219,562. Income from the railroad bonds was $399,691 and the loss due to depreciation $70,065, leaving a net return of $329,626. Therefore, the net difference in favor of public-utility over municipal bonds was $295,315 and over railroad bonds $184,891. Public-utility bonds selected for this comparison should meet the following requirements: First, the net earnings should be equal to one and three-quarters times the interest charge; second, the corporation should have gross earnings equal to or exceeding $500,000; third, the original distribution of the issue among investors should be made by a prominent and conservative banking house or banking houses. As a safe division of gross earnings Mr. Oldham suggested 70 per cent for operation and depreciation, 20 per cent for bond interest and 10 per cent for dividends. Upon the financial make-up of the public-utility company will depend its ability to finance itself economically or otherwise. A great responsibility rests upon the investment banker in accepting and marketing these securities. He should investigate the character and permanency of the field of operation and should see that the proper protection is afforded by the franchises, that the legal proceedings in connection with the issue have been properly taken, that the trust deed has been properly drawn, that the financial statements by the company are based on good accounting practice and can be relied upon to reveal the real financial position of the company—in short, he should investigate everything which may affect the integrity of the investment.

Business Notes

The Steel City Electric Company, of Pittsburgh, Pa., announced the appointment, effective Nov. 1, of the Ohio Distributing Company, Hearst Building, Chicago, as its sales representative in the Central West.

The Auto Electric Equipment Company, of Buffalo, N. Y., is starting to handle electric supplies and equipment for automobiles and motor boats and will establish a salesroom with a service and repair station at 721 Main Street, Buffalo.

The C & C Electric & Manufacturing Company, of Garwood, N. J., has made the following additions to its list of representatives: the Robertson-Cataract Company, 37 Court Street, Buffalo, N. Y.; the Gurley Engineering Company, Ellsworth Building, Chicago, Ill., and F. L. Robbins, Grubb Building, Salisbury, N. C.

The Bristol Company, of Waterbury, Conn., has taken over the business of the Goodwin Hollow Set Screw Company and has made arrangements for the exclusive manufacture of its product. Better facilities for manufacturing these set screws will be provided and shipments are now being made from the main factory of the Bristol Company.

The Multi-Lux Illuminating Studios Company, of Cleveland, Ohio, is making a new form of showcase reflector, which presents an unbroken line along the entire length of the case and is designed especially for use with the new straight-filament tungsten lamps recently put on the market. This concern is also putting out an emergency lighting unit for theaters, auditoriums and similar service. Mr. J. B. Shields is president of the company and Mr. F. C. Murdock its sales manager.

New Industrial Companies

The Star Advertising Company, of Springfield, Ill., has been incorporated with a capital stock of $1,500 by L. E. Wheeler, W. H. Conkling and J. H. Spurway. The company proposes to deal in electric signs, etc.

The Ampere Supply Company, of Ampere, N. J., has been incorporated with a capital stock of $100,000 by A. K. Solden, Jr., F. F. Townsend and R. R. Mitchel, of Ampere. The company proposes to manufacture electrical appliances.

The New England Cable Company, of Lowell, Mass., has been incorporated with a capital stock of $40,000 to manufacture and deal in insulated wires, etc. The incorporators are: D. J. Macdougall, S. Dunsford and T. F. Cuff, of Lowell.

The Metropolitan Appliance Company, of Chicago, Ill., has been incorporated by George W. LeVin, W. F. Cummings and W. J. Maher. The company is capitalized at $1,000 to manufacture and deal in mechanical and electrical devices.

The Mutual Electric Manufacturing Company, of Chicago, Ill., has been incorporated with a capital stock of $350,000 to manufacture and deal in electrical goods and appliances. The incorporators are: H. A. Boissat, T. Dimmock and E. C. Parsons.

The Freeport Tungsten Lamp Company, of Hoboken, N. J., has been chartered with a capital stock of $100,000 to manufacture tungsten lamps. The incorporators are: H. J. Jaeger, R. H. Herschman, of Hoboken, and G. V. Williams, of New York, N. Y.

The Automatic Safety Signal Company, of New York, N. Y., has been incorporated by Herman Ziegler, Paul R. Feig and Morris M. Becher, 538 West 143d Street, New York. The company is capitalized at $25,000 and proposes to deal in lamps and appliances.

The Struthers Manufacturing Company, of Peoria, Ill., has been incorporated with a capital stock of $200,000 to manufacture and deal in lightning rods, light fixtures, hardware specialties, etc. The incorporators are Reuben F. Struthers, John H. Owens and Arthur Otman.

Trade Publications

Water and Air Flow Meters.—Steam, water and air flow meters are exhaustively treated in Bulletin No. A4157, issued by the General Electric Company.

Electric Rainbow Fountain.—The Feature Advertising Company, 209 Pacific Street, Brooklyn, N. Y., has issued a small folder describing the "Rainbow Fountain" as an advertising feature.

Second-Hand Machinery.—MacGovern & Company, 114 Liberty Street, New York, have issued their November list of used electrical and steam machinery, cars, car equipment and other apparatus, indexed for easy reference.

Switch and Outlet Boxes.—The Chicago Fuse Manufacturing Company, 1014 West Congress Street, Chicago, has published Catalog No. 27, which illustrates and briefly describes its switch boxes and outlet boxes and covers,

Electrical Supplies.—With its new price list and discount sheet applying to Catalog No. 21, the Illinois Electric Company, 308 Madison Street, Chicago, is sending out a complementary order book for the convenience of its patrons.

Fixtures.—Catalog "C" of the National X-Ray Reflector Company, Chicago, shows its full line of "Eye Comfort" fixtures, printed in loose-leaf form. Catalog No. 17 illustrates and describes some new reflectors for show window and direct lighting.

Electrical Drills.—A fully illustrated description of the portable electrical drills and grinders made by the Cincinnati Electrical Tool Company, Cincinnati, Ohio, is given in Part I of Catalog No. 6. Part II is devoted to tool post grinders, bench, aerial, floor and internal grinders.

Oil Separators.—The Harrison Safety Boiler Works, Philadelphia, Pa., have recently published the last section—"E"—of Catalog No. 550, which pertains to low-pressure receiver oil separators, for removing oil and water from exhaust steam for use in low or mixed pressure turbines.

Electric Buses.—Field electric buses are the subject of a 24-page pamphlet recently issued by the Field Omnibus Company, Singer Building, N. Y. The booklet gives data in regard to the earnings, operation and maintenance of the Field bus, which is equipped with the Edison nickel-steel storage battery.

Electricity in Railway Terminal.—The important part that electricity plays in the New York terminal of the New York Central Railroad is described and illustrated in an artistic brochure of sixteen pages, issued by the General Electric Company under the title "Electricity on the New York Central." The information is well presented and is interesting alike to engineer and layman.

Thermometers.—The Hanovia Chemical & Manufacturing Company, Chestnut Street and New Jersey Railroad Avenue, Newark, N. J., has issued Supplement I, devoted to Heraeus quartz glass resistance thermometers, with special reference to telehygrometers for cold stores, breweries, cotton mills and wherever a knowledge of the humidity of the air and its measurement is of much importance.

Tube Cleaners.—Catalog M, issued by the Lagonda Manufacturing Company, Springfield, Ohio, contains information in regard to scientific scale removal by means of mechanical tube cleaners and some remarks on the harmful effects and reduction in economy resulting from the accumulation of scale in boiler, in condenser and in evaporator tubes. The catalog contains twenty-four pages and is fully illustrated.

Voltage Regulation.—Bulletin No. 4972, recently issued by the General Electric Company, describes its "KR" system of voltage regulation, which can be successfully employed on systems having such large fluctuations of voltage that the standard method is ineffective. The system described gives a broad range of excitation and the voltage furnished the fields of the main alternators is not limited either by the voltage range of the main exciters or the amount of current flow interrupted by the contacts of the regulator.

Personal Mention

Mr. A. A. Albany retired on Nov. 1 as manager of the Eastland (Tex.) Light & Power Company. He has been succeeded by Mr. G. W. Bishop.

Mr. G. Lundgren, formerly of the Cherokee (Ia.) Electric Company, has become manager of the Clear Lake (Ia.) Electric Light & Power Company.

Mr. W. D. Weaver, formerly editor of the *Electrical World*, has received from the French government the decoration (violet rosette) of Officier de l'Instruction Publique.

Mr. R. M. Jennings has been appointed manager of the Oregon Power Company at Marshfield, Ore. He was formerly manager of the Eugene (Ore.) division of the same company.

Mr. Zenas W. Carter, formerly secretary of the Electric Development Association of Boston, has been appointed manager of sales of the Ensign Manufacturing Company, builder of electric calculating machines, Boston, Mass.

Mr. F. E. McKenna, formerly manager of the new-business department of the Pacific Power & Light Company at Walla Walla, Wash., has recently been appointed manager of the Coquille plant of the Oregon Power Company.

Mr. A. Norman, formerly manager of the Freeport (Ill.) Railway & Light Company, has been appointed manager of the Eugene division of the Oregon Power Company, with headquarters at Eugene, Ore., succeeding Mr. R. M. Jennings.

Mr. J. J. Doyle, formerly assistant manager of the Central New York Gas & Electric Company, of Newark, N. Y., has been appointed manager of the electrical division of the properties of the Hagerstown & Frederick (Md.) Railway Company.

Mr. William G. Furlong, private secretary to the late A. N. Brady, has been elected secretary of the Municipal Gas Company, Albany, N. Y., succeeding Mr. E. P. Gabit, who has been promoted to the dual position of vice-president and treasurer.

Mr. Val A. Fynn, consulting engineer for the Wagner Electric Manufacturing Company, of St. Louis, Mo., has returned from his annual summer trip to Europe. Mr. Fynn is a mountaineer and a guide as well as a designer of single-phase motors.

Mr. Edward S. Mansfield has been appointed superintendent of operating bureau accounts of the Edison Electric Illuminating Company of Boston. Mr. Mansfield was born in Wakefield, Mass., in 1870, and in 1889 entered the employ of the General Electric Company at Schenectady, N. Y., where he was engaged for three years. In 1892 Mr. Mansfield entered the Massachusetts Institute of Technology, from the electrical engineering department of which he was graduated in 1896. During the vacation periods he worked in various capacities for the Boston Edison Company, and after his graduation he obtained a permanent position with the company as a statistician in President Edgar's office. He subsequently became head of the correspondence division in charge of the real estate of the company and later head of the statistical division in charge of the electric vehicle division. His work in connection with the electric vehicle division has been eminently successful. Owing to the rapidly broadening scope of the work of the operating bureau it was necessary to create a new office of superintendent of operating bureau accounts, to which Mr. Mansfield has just been appointed. Mr. Mansfield is a director of the Electric Vehicle Association of America, vice-chairman of the New England Section of the association, and vice-president of the Electric Motor Car Club of Boston.

EDWARD S. MANSFIELD

Mr. Howard R. Sargent, managing engineer of the wiring supplies department of the General Electric Company, and a candidate for alderman of the Eleventh Ward, Schenectady, N. Y., on the Citizens' ticket, was elected to that office on Nov. 5 by the largest plurality given to any alderman in the city in that election. The entire Schenectady Socialistic ticket was defeated.

Mr. L. E. Polhemus, mechanical and electrical engineer of the Ventanas Mining & Milling Company, Ventanas, Durango, Mexico, has joined the staff of the Nevada-California Power Company at Bishop, Cal. Mr. Polhemus was previously mechanical and electrical engineer of the Cubo Mining & Milling Company at Guanajuato, Mexico, and for four years was assistant master mechanic of the Mexican Light & Power Company at Nacaxa, Mexico. He left Mexico owing to the activity of the rebel forces in the State of Durango.

Mr. Homer E. Niesz, for several years manager of the Cosmopolitan Electric Company of Chicago, has been made secretary of the budget and expense committee of the Commonwealth Edison Company, following the absorption of the Cosmopolitan company by the Commonwealth company. This committee, of which Vice-president L. A. Ferguson is chairman, has an important function in the administration of the great Chicago electric service organization. For a number of years Mr. Niesz was connected with the Chicago Edison Company, predecessor of the Commonwealth company, so that he is returning to his old home and associates. Mr. Niesz is widely known among electrical men. He is chairman of the Chicago Section of the Electric Vehicle Association and Jovian statesman for Chicago.

Mr. Ell C. Bennett, who was re-elected Mercury at the recent Jovian Congress held in New York City, was born at Hannibal, Mo., Sept. 15, 1878, his parents having moved from Virginia to Missouri shortly before his birth. Mr. Bennett was brought to St. Louis at the age of four by his mother, who had owned and edited the Hannibal *Courier*, a daily newspaper, when she disposed of her interests in that paper and moved to St. Louis as part owner and associate editor of the *Missouri Republican*. Mr Bennett was educated in the public schools of St. Louis and, his family having met with financial reverses, he started to work at the age of fifteen. For three years he worked in the office of Lieut.-Gov. Charles P. Johnson of Missouri, and for four years in the office of Probate Judge J. Gabriel Woerner, of St. Louis, What leisure time he possessed was devoted to acquiring proficiency in shorthand reporting at night school and also in studying law. The untimely death of Judge Woerner upset his plans for becoming an attorney, and increasing responsibility at home made it necessary for him to enter commercial life. He began as a clerk in the Liggett & Myers Tobacco Company, became cashier and traveling passenger agent for the White Star Line, went into the shoe business and finally took up publicity work. He organized and operated the Electric St. Louis Publishing Company, publisher of load-building magazines for central stations, of which he is at present president and managing editor. Mr. Bennett's Jovian work began as a special investigator of the work of the central offices then located in Chicago, at the solicitation of Jovians and by appointment from Ninth Jupiter J. Frank Dostal in the last three months of the latter's incumbency. Mr. Bennett was elected Mercury and put in sole charge of the Jovian central offices at the Ninth Jovian Congress, held in Denver, October, 1911. He was re-elected at the Pittsburgh Congress and again at the New York Congress. In 1903 he married Katherine Louise Bain, of St. Louis, and is now the father of a family consisting of three boys and two girls.

ELL C. BENNETT

Mr. H. C. Hoagland has been appointed general manager and treasurer of the Fort Smith (Ark.) Light & Traction Company, succeeding Mr. J. W. Gillette, resigned. Mr. Hoagland will also retain his position as general manager of the Muskogee (Okla.) Gas & Electric Company.

Mr. A. J. Reed, recently connected with the Dayton office of the Westinghouse Electric & Manufacturing Company, has severed his connections with that company to assume duties with the Robbins & Myers Company in the capacity of manager of its newly opened branch office in Cleveland, Ohio.

Mr. Charles E. Mann, until recently clerk of the Massachusetts Railroad Commission and acting secretary of its successor, the Massachusetts Public Service Commission, has been appointed executive secretary of the board and will take charge of the records of the commission's proceedings and have the custody of its documents.

Mr. Andrew A. Highlands has been appointed secretary of the Massachusetts Public Service Commission, with headquarters at 20 Beacon Street, Boston. Mr. Highlands is a native of Fall River, Mass., and was graduated from the Harvard Law School in 1898. He will have general charge of the correspondence and office work of the Public Service Commission.

Obituary

James H. Ryan, of Chicago, a sales agent for the General Electric Company, died on Oct. 22. Mr. Ryan was a member of the Electric Club of Chicago.

Grafton Stevens, of Chicago, by profession a mechanical engineer and vice-president of the Oelwein (Ia.) Light, Heat & Power Company, was burned to death, with his wife, in their suburban home at Wilmette on Oct. 31. Mr. Stevens was graduated from the Armour Institute of Technology in 1903 and went with H. M. Byllesby & Company as an assistant to Mr. H. B. Brydon, of the engineering department, in 1907. He was greatly liked by his employers and associates. He resigned from the Byllesby organization in April of this year and opened an office in Chicago for himself as a manager of utility properties, acquiring an interest in the Oelwein plant. Mr. Stevens was a member of the American Society of Mechanical Engineers, the Phi Kappa fraternity, the Hamilton Club of Chicago and other clubs.

James Pass, of the well-known firm of Pass & Seymour, Syracuse, N. Y., died at his home in that city Oct. 30, at the age of fifty-seven. Mr. Pass was born in Burslem, Staffordshire, England, June 1, 1856, and came to the United States with his parents when seven years of age. His father, Richard Pass, was a manufacturer of pottery and first settled in Cincinnati, later in Trenton and finally in Syracuse. His son, James, was apprenticed to a pottery manufacturer at Trenton, and when he came to Syracuse at the age of eighteen was made foreman in the Onondaga pottery. He afterward succeeded his father as superintendent of the pottery, soon became general manager and later vice-president of the works. In 1890, with Mr. Seymour, Mr. Pass formed the firm of Pass & Seymour, manufacturers of porcelain insulation, etc. Mr. Pass was at one time president of the United States Potters' Association and was a charter member of the American Ceramic Society. He was also a member of the Engineers' Club of New York, the Syracuse section of the American Chemical Society and the Century, Citizens' and Country Clubs of Syracuse. He is survived by his widow, two sons and a daughter.

JAMES PASS

Construction

New England

GREENVILLE, N. H.—The Greenville El. Ltg. Co. expects to purchase within the next month one marine set with 5-kw to 10-kw generator, one small 5-kw to 10-kw steam turbine with generator; also one 2-kw to 3-kw direct-current generator to use as an exciter for a 60-kw alternating-current generator. H. J. Taft is treasurer.

BRISTOL, VT.—The Lake Dunmore Pwr. & Trac. Co., of Bristol, expects to purchase an additional boiler, smokestack and turbine waterwheel. E. D. Blackwell is manager.

BURLINGTON, VT.—The Municipal Electric Light Department of Burlington expects to erect within the next two months 3 miles of 2300-volt primary transmission line and to purchase two 300-hp Sturtevant fuel economizers and 40 new street-lamp fixtures to be operated on an extension of one of the present circuits. A new breakwater is now being built at the power house on Lake Champlain to protect the circulating water intake well. L. R. McBroom is manager.

CONCORD, MASS.—The managers of the municipal electric-light plant have contracted for and will soon install a 500-kw turbo-generator set and jet condenser, and will also purchase within the next three months meters, transformers and line material to take care of the regular service; also heating appliances and household labor-saving devices as called for. A. W. Lee is manager.

EASTHAMPTON, MASS.—The State Board of Gas and Electric Light Commissioners has granted the Easthampton Gas & El. Co. permission to issue $100,000 in additional capital stock, making a total of $450,000.

TORRINGTON, CONN.—The Connecticut River Pwr. Co. (controlled by the Stone & Webster Corpn., of Boston, Mass.) has begun work on the construction of a substation in Torrington to distribute electricity here. The company is building a large hydroelectric power plant at Falls Village, on the Housatonic River, and will transmit electricity to the local substation at 66,000 volts.

Middle Atlantic

BUFFALO, N. Y.—The Board of Estimate has instructed the committee on lamps and the commissioner of public works to submit a general plan and estimates of cost for the installation of a municipal electric-light plant.

GOWANDA, N. Y.—The State Conservation Commission has approved the plans and specifications submitted by the Keyes El. Co., of Gowanda, for the construction of a dam in the Cattaraugus Creek (No. 55, Erie watershed) in the towns of Persia and Collins.

KINGS PARK, N. Y.—Bids will be received by the State Hospital Commission, Capitol, Albany, until Nov. 21, for furnishing additional power house equipment, boilers, air compressor and connections, new elevators and wiring thereto at Kings Park State Hospital, Kings Park, N. Y. Drawings and specifications may be seen and blank forms of proposals obtained at the Kings Park Hospital, office of the State Hospital Commission, No. 1 Madison Avenue, New York, and at the office of the state architect, Capitol, Albany. Plans and specifications will be furnished upon application to Lewis F. Pilcher, state architect. J. H. B. Hanify is secretary.

MANLIUS, N. Y.—W. J. Phillips, owner of the local electric-light plant, has applied to the Public Service Commission for permission to extend his transmission lines from the eastern limits of the village of Manlius through the towns of Manlius and Sullivan to the village of Chittenango. Mr. Phillips was recently awarded a contract for street-lighting in Chittenango.

NEW YORK, N. Y.—Bids will be received by the Department of Public Charities, foot of East Twenty-sixth Street, New York, until Nov. 13, for furnishing material and labor for installation of additional mechanical equipment for the power house and laundry building at Randall's Island. Blank forms and further information may be obtained at the office of Frank J. Helme, architect, 190 Montague Street, Brooklyn, where plans and specifications may be seen.

RANSOMVILLE, N. Y.—The Lake Shore Pwr. Co. has applied to the State Highway Department for permission to erect a transmission line from Lewiston to Ransomville. The company purchases electricity from the Niagara, Lockport & Ontario Pwr. Co. and is now furnishing electrical service in Wilson.

CHERRY TREE, PA.—The Cherry Tree El. Ht., Lt. & Pwr. Co. has discarded its arc lamps and has erected about 40 100-watt incandescent lamps throughout the town. C. J. Cameron is secretary and treasurer.

HUMMELSTOWN, PA.—The Hummelstown Consol. Wtr. Co. is rebuilding its lines in Hummelstown and to Swatara and expects to purchase one 150-kw, three-phase, 2300-volt generator to take the place of a smaller machine. J. E. Nicholson is superintendent.

JUNIATA, PA.—The Raystown Wtr. Pwr. Co., of Huntington, has applied to the Borough Council for a franchise to furnish electrical service in Juniata.

NEW WILMINGTON, PA.—The managers of the municipal electric-light plant expect to purchase one new 70-hp Pennsylvania boiler, one 40-kw and one 50-kw direct-current generator and one 75-hp Foss gas engine, with switchboard equipment, motors, switch and breaker and poles, lightning arresters, meters and incandescent lamps. J. B. Anderson is engineer.

OLYPHANT, PA.—The electric light commissioners expect to purchase within the next six months one 50-lamp tub transformer. M. P. Malley is secretary.

WILSON, PA.—The Eastern Pennsylvania Pwr. Co., of Easton, has submitted a proposition to the commissioners of Wilson Township for lighting the streets of the town.

DOVER, DEL.—The town of Dover is making several improvements to the municipal electric-light plant, including changing the system from single-phase to three-phase, material for which has been purchased. A 200-kva generator manufactured by the Fort Wayne El. Works has been ordered. T. F. Cooke is superintendent.

CLIFTON FORGE, VA.—The Virginia-Western Pwr. Co., of Clifton Forge, has recently placed contracts for the following equipment, which will soon be installed in the new addition to its power house: To the General Electric Co. for one 750-kw Curtis steam turbine; Heine Safety Boiler Co., of St. Louis, Mo., for one 400-hp boiler; Henry R. Worthington, of New York, N. Y., for one surface condenser, and Paul C. Crowe for stokers for boilers. A. C. Ford is manager.

WESTPOINT, VA.—The People's Lt., Ht. & Pwr. Corpn., of Westpoint, expects to purchase within the next three months one 250-hp boiler, one 200-hp simple four-valve or compound slide-valve engine directly connected to a 150-kva alternator and a three-panel switchboard. C. L. Maskey is president.

WEYER'S CAVE, VA.—The Weyer's Cave Lt. & Pwr. Co. expects to erect within the next few months 1 mile of distribution line into the farming country adjoining Weyer's Cave. L. E. Long is secretary and treasurer.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Nov. 14, for one steel tower for radio station (250 ft. high), approximate weight 65,000 lb., in accordance with specifications 510a. Major W. L. Clarke is disbursing officer.

WASHINGTON, D. C.—Bids will be received at the office of the chief signal officer, War Department, Washington, D. C., until Nov. 20, for furnishing the following supplies: One common-battery lamp line, three-position, 600 common-battery lines, 40 magneto lines and 45 cord circuits, completely wired switchboard, but only equipped for 400 common-battery lines, 20 magneto lines and 30 cord circuits, as per proposal No. 681. This switchboard is for installation in the tropics. Major W. L. Clarke is disbursing officer.

WASHINGTON BARRACKS, D. C.—Bids will be received at the office of the engineer depot, United States Army, Washington Barracks, D. C., until Nov. 14 for furnishing eight ventilating blowers connected to 110-volt, alternating-current, single-phase motors (right-hand); two 18-in. disk or propeller fans directly connected to 110-volt, alternating-current, single-phase motors, complete with solder, and four 18-in. disk or propeller fans directly connected to 110-volt direct-current motors, complete, with inclosed starting rheostat and main switch. Further information may be obtained upon application to Lt.-Col. Joseph E. Kuhn.

North Central

JACKSON, MICH.—The State Railroad Commission has authorized the Economy Pwr. Co., of Jackson, to increase its capital stock by $1,630,000, the proceeds to be used to pay outstanding indebtedness and for the development of plants recently acquired.

KALAMAZOO, MICH.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Nov. 28 (change of date from Nov. 27) for a conduit and wiring system, etc., in the United States post office in Kalamazoo, Mich.

CALDWELL, OHIO.—Bids will be received by the Board of Public Affairs, Caldwell, Ohio, until Nov. 24 for furnishing material, labor and machinery for remodeling and equipping the electric-light plant and waterworks system. The work will include the construction of a new power station and new equipment, consisting of a vertical multi-cylinder natural-gas engine having a rating of at least 120 hp, to drive an 80-kva Fort Wayne alternating-current generator, now located at the old plant, and a new switchboard with instruments. New transmission lines will be erected to the new power house. Arc lamps on the court house square will be replaced with tungsten lamps erected on ornamental standards. Meters will also be required. The compound pump which is now in use at the water-works station will be replaced by a new belt-driven power pump of approximately the same capacity. A cylinder horizontal natural-gas engine (approximately 80 hp, belt-driven) will be installed to drive the new pump. Bids will be received on the above as a whole or any part. Plans and specifications may be seen at the office of the board. T. P. Glidden is clerk.

CLEVELAND, OHIO.—The contract for general building construction of the municipal electric-light plant has been awarded to W. B. McAllister Co., of Cleveland, for $60,800, to be completed in 100 days.

COLLEGE CORNER, OHIO.—The Town Council has granted a franchise to John H. McCray to construct and operate an electric-light plant in College Corner. Later the Council will enter into a contract with Mr. McCray for lighting the streets with 20 or more street lamps.

GREEN SPRING, OHIO.—The electric plant of the Green Spring El. Lt. & Pwr. Co. was entirely destroyed by fire on Oct. 26. The town will be without electrical service for several weeks.

MAUMEE, OHIO.—It is reported that interests controlling the Auglaize Pwr. Co., the Defiance Gas & El. Co., the Valley Lt. & Pwr. Co. and the Maumee Valley El. Co. are contemplating the construction of a 3000 hp steam-power plant in Maumee, to be used as an auxiliary to the hydroelectric power plants. The headquarters of the company are in Defiance. W. P. Wallace is general manager.

NEW BREMEN, OHIO.—The City Council is reported to be considering the question of contracting with the Western Ohio El. Ry. Co. to furnish electricity to operate the municipal electric-light plant and waterworks system.

OAKWOOD, OHIO.—The Village Council is contemplating the installation of an electric-light system. It is proposed to install an electric generator in connection with the power plant in the tile yard.

TOLEDO, OHIO.—The Toledo Rys. & Lt. Co. is installing a 12,500-kw General Electric horizontal steam turbine with a Westinghouse Le-Blanc surface condenser, which will be put in operation about Dec. 1. The company is also installing five Stirling boilers with a rating of 3300 hp and a 1000-kw rotary converter for the down-town lighting system. A 1500-kw Westinghouse frequency changer has just been added to the plant.

WINDHAM, OHIO.—The power plant of the Windham El. Co. was closed down last June and energy for operating the local system is secured from the Trumbull Pub. Ser. Co., of Warner, which has erected a 22,000-volt transmission line through Windham to Garrettsville. The company has established a 24-hour service in Windham and is extending its distribution lines into the country to furnish the farmers with electricity for lamps and motors.

WOOSTER, OHIO.—The Wooster El. Co. has placed a contract with the Allis-Chalmers Co. for a new generating unit, consisting of a 350-kw alternating-current generator and other machinery, to cost $13,000.

CARROLLTON, KY.—Plans are being considered for making improvements to the municipal electric-light plant, including changing the system from direct current to alternating current.

CLAY, KY.—Preparations are being made by the Clay Lt. & Ice Co. for the installation of a 75-kva, 2200-volt Fort Wayne generator and an Erie Ball engine; equipment already purchased, also material for distribution system, including poles, cross arms, insulators and wire. Transformers have not yet been purchased. The company will purchase at once fixtures for about 5000 lamps. C. R. Clark is secretary.

CONNERSVILLE, IND.—The Hydro-Electric Lt. & Pwr. Co., of Connersville, has installed within the past few months a 500-kw steam turbo generator set and 25-kw motor generator exciter set, two 280-hp Stirling boilers, chain grate stoker, surface condenser and additional switchboard equipment for generator and exciter. W. E. Lowe is superintendent.

MISHAWAKA, IND.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 8, for the construction, including mechanical equipment, electric conduit and wiring system, interior lighting fixtures and approaches, of the United States post office at Mishawaka, Ind. Drawings and specifications may be obtained from the above office or from the custodian at Mishawaka. O. Wenderoth is supervising architect.

NEW CARLISLE, IND.—The managers of the local electric-light plant are contemplating the purchase of some poles. George W. Doughty is clerk.

NOBLESVILLE, IND.—The Noblesville Ht., Lt. & Pwr. Co. has erected during the last five months 15 miles of distribution lines through the farming districts to furnish electrical service on the farms. John T. Kester is manager.

CHESTER, ILL.—A new boiler, engine and generator has recently been installed in the Chester light and ice plant. J. Fred Gilster is secretary and treasurer.

FARMER CITY, ILL.—The managers of the municipal electric-light plant expect to purchase within the next 12 months about 24 ornamental lamp posts for cluster lamps.

FITHIAN, ILL.—At an election held recently the proposition to purchase the local electrical distribution system and franchises, owned by O. B. Wynsong, was carried.

GENEVA, ILL.—The city of Geneva expects to purchase within the next eight months two boilers and one motor-driven air compressor. Olaf Peterson is superintendent.

JACKSONVILLE, ILL.—An ordinance has been introduced in the City Council providing for a bond issue of $50,000 to equip the municipal electric-light plant to furnish electricity for commercial and city lighting.

JACKSONVILLE, ILL.—The Jacksonville Ry. & Lt. Co. expects to erect within the next few months a switchboard gallery and to purchase two 300-hp boilers and an 8-ft. by 150-ft. smokestack, new switchboard panels and material to put the present installation in first-class order. The company also expects to rebuild its 2300-volt transmission lines throughout the city within the next three weeks. W. N. Christensen is operating engineer.

KENNEY, ILL.—The Mount Pulaski El. Lt., Ht. & Pwr. Co., of Mount Pulaski, will take over the plant of the Kenney El. Co. by Jan. 1, 1914, and will furnish electricity to operate the local system from its plant at Mount Pulaski.

NAUVOO, ILL.—The City Council has awarded a contract for street-lighting to Joseph Nelson, president of the Nauvoo El. Lt. & Pwr. Co. The contract calls for thirty 350-watt tungsten lamps.

PEORIA, ILL.—A petition has been presented to the City Council by residents on Barker Avenue (from University Avenue to Western Avenue) for the installation of ornamental lamp standards. They agree to furnish the standards, provided the city will maintain the lamps.

ROCKFORD, ILL.—The installation of an ornamental lighting system on Seventh Street, from Charles Street to Railroad Avenue, is contemplated by the Seventh Street business men.

SULLIVAN, ILL.—The City Council (it is reported) is contemplating equipping the municipal electric-light plant to furnish electricity for commercial lighting.

WARSAW, ILL.—The installation of an ornamental street-lighting system in Warsaw is under consideration.

WATSEKA, ILL.—A movement has been started by the business men for the installation of an ornamental street-lighting system in the business district. Iron standards carrying five-lamp clusters will probably be used. Julius Shapiro is interested.

MENOMONIE, WIS.—The City Council has awarded the Chippewa Valley Ry. & Ltg. Co., of Eau Claire, a contract to light the streets of the city for a period of four years.

CROOKSTON, MINN.—The Red River Farm & Land Co., of Crookston, is now erecting a hydroelectric power station and dam on the Red Lake River, about 4 miles above the city, and will put in operation one unit next month. The company has purchased one 750-hp, 90 r.p.m. Smith turbine and one 500-kva Westinghouse horizontal generator with switchboard and exciter unit. E. Peterson is treasurer.

EVELETH, MINN.—The Home El. & Htg. Co., of Eveleth, has recently installed two Jones underfeed stokers with auxiliary apparatus in its plant. R. M. Dungan is general manager.

GILBERT, MINN.—The St. Louis Pwr. Co., it is said, will soon begin work on the erection of a transmission line from Gilbert to Biwabik, where it was recently awarded a contract to furnish electricity to operate the municipal electric-light system.

ADAIR, IA.—Orders were placed Oct. 10 for a 150-hp Ridgway engine, a 100-kw generator, switchboard and all accessories, to be installed at once. C. E. Morse is superintendent of light and power plant.

CENTERVILLE, IA.—The Centerville Ltg. & Trac. Co., it is reported, will install a new engine and generator, directly connected, in its power plant.

DEDHAM, IA.—Application has been made to the town of Dedham by John Neuburg for a franchise to install and operate an electric-light system in Dedham.

DENISON, IA.—The Denison El. Lt. & Pwr. Co. expects to build a new power station and erect 28 miles of transmission lines within the next eight months; also to purchase three 72-in. by 18-ft. boilers, two Corliss engines, one 200-kva and one 125-kva generator, two boiler-feed pumps, one car load of 25-ft. poles and one car load of 30-ft. poles with 6-in. tops, one tub transformer and 300 6-amp tungsten lamps within the next six months. Within the next 12 months the company expects to purchase a sample of most of the cooking apparatus as well as heating devices. E. Gulick is president.

GERLED, IA.—It is reported that a movement is on foot for the construction of an electric plant in Gerled to furnish electricity in Bancroft, Swea City, Ledyard and Germania.

GLIDDEN, IA.—Of the proceeds of $10,000 in bonds (recently authorized), $5,400 will be used to take up outstanding indebtedness and the remainder for the purchase of an additional unit for power plant. Contracts have been placed for a 175-hp Ridgeway engine and 100-kva generator (directly connected). O. B. Morehouse is city clerk.

GREENE, IA.—The Greene Lt. & Pwr. Co. expects to purchase within the next few months a storage battery. R. Miner is secretary.

McGREGOR, IA.—The McGregor Lt. & Pwr. Co. has been granted a 25-year franchise to furnish electricity for lamps and motors in McGregor, and to erect and maintain a transmission line to Monona. The company will also furnish electrical service to farmers residing along the route of the proposed transmission line.

MEDIAPOLIS, IA.—Work has begun on the installation of a street-lighting system in Mediapolis, consisting of 50 tungsten lamps. A temporary steam plant will operate the electric generator until next spring when the transmission line of the Mississippi River Pwr. Co. will be extended from West Burlington northward to serve Morning Sun and other towns in that vicinity.

MILFORD, IA.—A franchise has been granted to O. E. Logan, of Sheldon, to install and operate an electric-light system in Milford.

MONONA, IA.—The Monona Lt. & Pwr. Co., recently incorporated, with a capital stock of $20,000, will erect a substation at the town limits,

connecting with the transmission line of the McGregor Lt. & Pwr. Co., which will furnish electricity to be distributed by the Monona company. W. A. Wellman, L. N. Nelson and H. Wellman, all of Monona, are interested in the Monona company.

OELWEIN, IA.—A special election will be held Nov. 18 to vote on the proposition to grant a franchise to the Oelwein Lt., Ht. & Pwr. Co. A. F. Heeb, T. J. Mulgreen and T. J. Fitzpatrick, all of Dubuque, Ia., are interested in the company. An item published Oct. 18 stated that a franchise has been given to the above parties. C. D. Sheppy is city clerk.

ROCKWELL CITY, IA.—The local electric-light plant was recently purchased by H. B. Rutledge, of Minneapolis. The new owner has contracted for considerable new equipment, which will be installed at once.

WASHINGTON, IA.—The railroad companies, it is said, will pay for electroliers at all railroad crossings and the city will maintain them.

EDINA, MO.—The Edina Lt. Co. expects to purchase within the next three months one 150-hp boiler and one 125-hp Corliss engine, and within the next six months it expects to purchase a series tungsten lamp street-lighting system. M. C. Hunter is secretary and treasurer.

FAYETTE, MO.—The Fayette Lt., Ice. & Coal Co. expects to purchase within the next 12 months one Corliss engine direct-connected to a 200-kw to 250-kw, three-phase, 60-cycle, 2300-volt generator. The company would like to purchase a good second-hand outfit. John B. Bell is president.

LA PLATA, MO.—The property of the La Plata Lt. & Pwr. Co., consisting of an electric-light plant, water-works system and ice factory, has been purchased by Abraham Vogel, formerly connected with the Bowling Green El. Lt. Co.

MAPLEWOOD, MO.—The Board of Aldermen has granted the Independent Lt. & Pwr. Co. a franchise to furnish electricity for lamps and motors in Maplewood. The company was also given a contract for street-lighting, under the terms of which the company is to furnish street lamps of 100 cp at $15 each per year. The franchise and contract will be submitted to the voters for approval. H. P. Taussig, president of the Western Manufacturers Co., of St. Louis, and Horace C. Pugh, of Terre Haute, Ind., are interested in the company.

DALLAS, S. D.—The Martin El. Lt. & Pwr. Co., of Dallas, S. D., expects to purchase within the next three months transformers, lightning arresters, insulators, meters, etc.; also electrical appliances, including heating and cooking apparatus, vacuum cleaners, washing machines, etc. B. H. Martin is president and manager.

FLANDREAU, S. D.—The Flandreau Lt. & Pwr. Co. expects to extend its service to Egan and Coleman within the next six months, to furnish electrical service in both towns. A. H. Savage is treasurer.

HENRY, S. D.—The Henry Lt. & Pwr. Co. expects to purchase within the next two or three months one 18-kw or 20-kw, 125-volt direct-current generator and some meters. Ernest Reincke is secretary and manager.

LENNOX, S. D.—The Lennox Milling Co., recently incorporated, with capital stock of $30,000, proposes to supply electricity in Lincoln County, covering a territory of 25 miles. The company will also operate a flour mill. H. B. McFarland, T. K. Colesfi, of Lenox, and A. B. McFarland, of Centerville, are interested in the company.

SALEM, S. D.—The Salem Milling, Ltg. & Htg. Co. expects to purchase soon a 60-in. by 16-ft. horizontal tubular boiler. The company is also interested in condensing apparatus. L. V. Schneider is president and manager.

ALMA, NEB.—The managers of the municipal electric-light plant expect to purchase within the next 30 days one 150-kva generator and a 5-kw, 125-volt exciter; also to purchase within the next six weeks switchboard equipment, including one exciter panel, one distributing panel, one series incandescent panel with accessories; also interior wiring supplies, heating appliances and labor-saving devices within the next month. A. H. Reed is city clerk.

COLUMBUS, NEB.—The Columbus Lt., Ht. & Pwr. Co. is now installing a 550-hp compound condensing engine and a 450-kva alternator and will soon install a 15-ton ice manufacturing plant. Willis Todd, 214 First National Bank Building, Omaha, is general manager.

DAVID CITY, NEB.—The city of David City expects to purchase within the next 12 months one 200-hp water-tube horizontal boiler, one 150-kw and one 75-kw generator, a three-panel or four-panel switchboard, two small exciters for above generators for the municipal electric-light plant; also wire meters, lightning arresters, insulators, poles, 25 or 30 transformers, wiring supplies, washing machines, flatirons, etc. Henry J. Bremers, Jr., is water and light commissioner.

FUNK, NEB.—The local electric-light plant, owned by O. Cobb, was recently purchased by A. S. Erickson.

GRAND ISLAND, NEB.—The Water and Light Commission is now installing one 500-kw Allis-Chalmers turbine and condensing apparatus and also 140 ornamental standards carrying five-lamp clusters. J. H. Miller is water and light commissioner.

LINCOLN, NEB.—Since Oct. 15 the municipal electric-light plant has been furnishing electricity for commercial lighting. The Water and Light Commission expects to purchase at once transformers, lightning arresters, meters and incandescent lamps; also within the next few months condenser for water and light plant. Paul W. Doen is assistant water and light commissioner.

Southern States

WENDELL, N. C.—The Lee mill property on Little River, 2 miles east of the city, is reported to have been purchased by the city of Wendell on which a hydroelectric power plant will be erected to supply electricity to light the city.

WILSON, N. C.—The date for receiving bids for electric power-plant equipment (advertised to be received Nov. 4) has been postponed indefinitely. Parties having received specifications are requested to preserve them, as it is the present intention to call for bids at some future date on the same specifications. Gilbert C. White, of Charlotte, N. C., is engineer, and D. S. Boykin is chairman of Board of Public Works.

BENNETTSVILLE, S. C.—The Board of Public Works expects to erect within the next 30 days a 2300-volt transmission line to the grounds of the Marlboro County Fair Association, material for which has been purchased. The company also expects to purchase within the next six months three-wire underground cable for maintaining street-lamp standards and transformers for same. Within the next three months the company expects to purchase additional five-lamp and one-lamp standards for street-lighting. E. C. Morrison is manager.

MOUNT PLEASANT, S. C.—The Isle of Palms Improvement Co., of Charleston, will build a new substation in Mount Pleasant, work on which will begin Jan. 1, 1914. The equipment will include a seven-panel switchboard, two 300 kw rotary converters, 6600-volt, primary, 60-cycle. The distribution system will consist of 2 miles of aerial three-phase pole line. A transmission line about 2 miles long will be erected with 1¼ miles of submarine cable additional to connect the substation in Mount Pleasant with the power station in Charleston. Contract has practically been placed for the above line. The submarine cable will be laid across the Cooper River. W. W. Fuller, of Charleston, is engineer in charge.

BRUNSWICK, GA.—The Mutual Lt. & Wtr. Co., of Brunswick, expects to purchase within the next year one 250-hp water-tube boiler. The company also contemplates changing its system from 125 cycles to 60 cycles. The city has purchased 50 lamp-posts and material for an ornamental street lighting system, which the company will install. J. M. Armstrong is superintendent.

FORT GAINES, GA.—Bonds to the amount of $8,000 have been voted for the installation of a municipal electric-light plant.

MARSHALLVILLE, GA.—Plans are being considered for the installation of a municipal electric-light plant. The present plans provide for a 50-kva plant and 3 miles of transmission lines, 30 lamps of 100 cp and 1000 16-cp lamps. E. L. Sammons is secretary.

AVON PARK, FLA.—The installation of an electric-light plant in Avon Park is under consideration. The Board of Trade is said to be interested in the project.

CHIPLEY, FLA.—The Chipley Lt. & Pwr. Co. expects to erect within the next six months a 10-ton ice plant to be operated in connection with its electric plant. E. H. Hale is general manager.

CLERMONT, FLA.—The installation of an electric-light plant in Clermont is under consideration. J. F. Knapp is reported to be interested in the project.

MAYO, FLA.—At an election held recently the proposition to issue $15,000 for the installation of an electric light and ice plant was defeated. O. B. Dees, it is reported, will apply for a franchise to install an electric-light plant at once.

PENSACOLA, FLA.—Application has been made to the Board of County Commissioners by L. W. Harvey for permission to erect a dam on the lower Perdido River and to erect a large hydroelectric power plant. The proposed plant will furnish electricity in Pensacola, Mobile and other nearby cities.

JACKSON, TENN.—The Jackson Ry. & Lt. Co. expects to build within the next few months 2 miles of new street railway line and also to purchase a 250-kw rotary converter and four steel cars. John Wisdom is general superintendent.

JEFFERSON CITY, TENN.—The Jefferson City Milling & El. Co. expects to erect within the next four months a 5-mile transmission line for three-phase system; also to purchase a 75-kw, three-phase, 6600-volt generator and a 100-hp turbine wheel (possibly). C. A. Bales is manager.

MORRISTOWN, TENN.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 10, for construction, complete, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office at Morristown, Tenn. Drawings and specifications may be obtained at the above office or from the custodian of site at Morristown.

BRIDGEPORT, ALA.—The installation of an electric light plant in Bridgeport is under consideration. J. W. Adams, of Chattanooga, Tenn., and others are reported to be interested in the project.

HOLLENDALE, MISS.—The town of Hollendale recently purchased a 70-hp boiler and expects to install same within the next 30 days, making a battery of two boilers. T. H. Russell is clerk.

BEEBE, ARK.—The property of the Beebe Lt. & Pwr. Co. was recently purchased by A. C. Ward at a receiver's sale. Mr. Ward proposes to make improvements to the plant and eventually move the plant and operate it in connection with his machine shop.

MALVERN, ARK.—The Malvern El. Co. expects to erect within the next three months a new power house and also to purchase a 150-kw,

three-phase, 60-cycle, 2200-volt unit (directly connected), with switchboard and 75 meters. T. Edwards is manager.

NEWPORT, ARK.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 2, for the construction, including mechanical equipment, interior lighting fixtures and approaches, of the United States post office, in Newport, Ark. Drawings and specifications may be obtained at the above office or from the custodian of site at Newport. O. Wenderoth is supervising architect.

ARCADIA, LA.—The North Louisiana Lt. & Pwr. Co., of Arcadia, is considering two or three propositions in regard to the erection of high-tension transmission lines, but as yet nothing definite has been decided upon. J. B. Herring is president and general manager.

FRANKLINTON, LA.—The plant of the Franklinton El. Lt. & Pwr. Co. is reported to have been purchased by T. J. Hood, who, it is said, will enlarge it.

DURANT, OKLA.—The Durant Ice & Lt. Co. expects to erect within the next three months a new engine house. The company has purchased and expects to install within the next 90 days a 312-kva Westinghouse turbo-generator with Le Blanc condenser and switchboard. W. E. Riddle is cashier.

BRENHAM, TEX.—The Brenham Compress Oil & Mfg. Co. expects to erect within the next 30 days a 225-hp Diesel engine directly connected to a 200-kva, 60-cycle, 2300-volt Fort Wayne generator. Equipment has already been purchased. James C. Kennedy is secretary.

CANADIAN, TEX.—The Canadian Wtr., Lt. & Pwr. Co. expects to purchase within the next six months about 50 meters. J. S. Hood is manager.

GOLDWAITE, TEX.—The Goldwaite Lt. & Ice Co. expects to purchase within the next few months a 25-hp steam engine and a 15-kw to 20-kw, 220-volt generator. Edward Geeslin is manager.

MARSHALL, TEX.—The Marshall El. Co., it is reported, is contemplating increasing the output of its power plant from 525 hp to 725 hp. Two boilers of 400 hp each will also be installed.

SMITHVILLE, TEX.—The Smithville El. Lt., Wtr. & Pwr. Co. expects to purchase within the next three months a complete series street-lighting system, consisting of about 50 lamps. Emil Buescher is owner and manager.

Pacific States

EATONVILLE, WASH.—The City Council has decided to purchase electricity from the Tacoma municipal electric plant in preference to building a municipal plant. A transmission line will be erected from La Grande, bids for construction of which will be received until Nov. 14 by Charles C. Biggs, town clerk.

EDMONDS, WASH.—The Edmonds El. Lt. & Pwr. Co. has been granted a franchise to erect transmission lines in Kings County. Work will begin at once on the erection of a transmission line from Edmonds to Richmond Beach to furnish electricity for lamps and motors. W. R. Ammon is general manager.

NORTH YAKIMA, WASH.—The Pacific Pwr. & Lt. Co., of North Yakima, has applied to the County Commissioners for a franchise to erect and maintain a 3-mile transmission line to furnish electricity for irrigation and power purposes in the vicinity of Zillah.

PULLMAN, WASH.—The City Council has decided to install additional tungsten lamps in the down-town districts, including Grand Street, Olson Street and Kamicken Street and side streets.

SEATTLE, WASH.—A resolution has been adopted by the City Council appropriating $1,250,000 for the installation of a 5000-kw steam auxiliary power plant.

SEATTLE, WASH.—Permits have been granted by Secretary Houston to the Skagit Pwr. Co. for the development of water power on the Skagit and Cascade Rivers, in the Washington State National Forest. It is estimated that more than 50,000 hp can be developed.

SPOKANE, WASH.—Bids will be received until Nov. 13 by the City Council for installation, operation and maintenance of an ornamental street-lighting curb system on Riverside Avenue from Division Street to Washington Street, for a period of 10 years from the date of installation. Plans and specifications are on file in the office of C. M. Fassett, commissioner of public utilities.

SUMAS, WASH.—The Board of County Commissioners has granted the Sumas El. Co. a franchise to erect a transmission line from Sumas to Everson.

COQUILLE, ORE.—The property of the Coquille River El. Co., operating in Coquille and Myrtle Point, Ore., has been taken over by the Oregon Pwr. Co., a holding company of H. M. Byllesby & Co. The Oregon company is making arrangements to establish a 24-hour service and is now constructing a new steam plant, to be equipped with two 150-kw generators driven by individual engines. One unit was put in operation on Oct. 27. The company has secured contracts for street-lighting in both cities and has completed the installation of a series system in Coquille consisting of 20 three-lamp clusters on poles and 62 single lamps erected on brackets throughout the residence district. A similar installation, with a smaller number of lamps, is being installed in Myrtle Point, a General Electric constant transformer being used for each system. Electricity is supplied in Myrtle Point over a 10-mile, single-phase transmission line. This line will shortly be rebuilt and changed to a three-phase system. A new distribution system will be installed in Coquille immediately after the completion of the Myrtle Point series system, which will require approximately 4 tons of copper wire, which is being furnished by John A. Roebling's Sons. White cedar poles will be used exclusively. F. E. McKenna is manager.

MEDFORD, ORE.—The California-Oregon Pwr. Co., of Medford, Ore., expects to purchase within the next three months fifty 2200-volt lightning arresters and 50 electric ranges. H. C. Stoddard is division superintendent

NEWPORT, ORE.—The Yaquina El. Co., of Newport, expects to purchase within the next eight months transformers and meters as required by new business; also some flatirons. George Blanchard is manager.

PORTLAND, ORE.—The light committee of the City Council has announced that 660 electric arc lamps will be installed in various parts of the city during the coming year.

STOCKTON, CAL.—The Western States Gas & El. Co. of California, of Stockton, expects to purchase within the next 12 months material and apparatus for distribution system as needed for ordinary extensions, also material for 22 blocks of underground construction. Samuel Kahn is vice-president and general manager.

WILLITS, CAL.—The Willits Wtr. & Pwr. Co. expects to install within the next month one 100 kw General Electric generator. J. W. Heap is superintendent.

MULLEN, IDAHO.—The City Council has decided to replace the arc lamps on Main Street to the city limits east with tungsten lamps; all other streets throughout the city will also be lighted with tungsen lamps. The Hunter Mining Co. contemplates extending the new lighting system from the city limits to its properties.

POCATELLO, IDAHO.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 11, for construction, complete, including mechanical equipment and lighting fixtures, of the United States post office and court house at Pocatello. Drawings and specifications may be obtained from the above office or from the custodian of site at Pocatello. O. Wenderoth is supervising architect.

OGDEN, UTAH.—The power plant of the Utah Ry. & Lt. Co. was badly damaged by the breaking of a large valve controlling the water flow, causing a loss of from $50,000 to $100,000.

SALT LAKE CITY, UTAH.—Application has been filed with the state engineer by George H. Barnhart (an Eastern capitalist), requesting the use of 150 cu. ft. of water per second, to be diverted from the Uinta River in Wasatch County. The application states that the water is to be used for power purposes and that the length of the diverting channel will be 15 miles. E. C. Lackner, local attorney, filed the application.

JEROME, ARIZ.—The United Verde Copper and Upper Verde Public Utility Co., of Jerome, expects to install within the next six months a 1500-kw Allis-Chalmers turbine, with complete switchboard equipment; also to purchase equipment for the installation of an entire distribution system for a town of 2000 inhabitants. T. C. Roberts is chief engineer.

CASPER, WYO.—The L. L. Nunn Co., which was recently granted a franchise to furnish electricity in Casper, is reported to have taken an option on the Boysen dam and power plant, on the Big Horn River, 100 miles west of Casper. The purchase price is said to be $4,000,000. If the deal goes through, a transmission line will be erected to Casper.

Canada

CALGARY, ALTA.—Bids will be received until Nov. 16 by J. J. Miller, city clerk, for furnishing one 1000-kw synchronous motor-generator and exciter set.

CALGARY, ALTA.—The City Council has entered into an agreement with the Calgary Pwr. Co. to purchase 5000 hp per year for a period of five years at $26 per hp per year.

WINNIPEG, MAN.—The Winnipeg El. Ry. Co. has secured the Great Falls Pwr. Co.'s water rights on the Winnipeg River, situated midway between Lac du Bonnet (the site of the company's present plant) and the mouth of the river.

NEWCASTLE, N. B.—The corporation of Newcastle is considering the establishment of a 24-hour service. The inauguration of a day service will necessitate the installation of an additional generator and engine at the power house.

BROUGHTON, N. S.—The Cape Breton Coal, Iron & Ry. Co. is contemplating installing electrical equipment in its collieries. Two units of 1000 kw each will be installed. C. J. Coll is general manager.

BROCKVILLE, ONT.—The Town Council has passed a by-law authorizing a further expenditure of $69,000 for improvements to the light and power department.

SANDWICH, ONT.—Arrangements have been made between the Essex County Lt. & Pwr. Co., of Windsor, and the Canadian Salt Co., of Sandwich, whereby the former will purchase steam power from the latter. A new 715-kw steam turbine will soon be installed in the plant of the Essex County Lt. & Pwr. Co. in Sandwich.

ST. CATHARINES, ONT.—The Hydro-Electric Power Commission has submitted estimates to the Grantham Council to furnish electricity to Grantham Township. A by-law will soon be submitted to the voters. Other townships in Lincoln County will soon apply to the commission for electrical service.

YORK, ONT.—The Township Council will apply for an order-in-council giving it authority to enter into a temporary agreement with a private company to provide street-lighting service in the districts on the outskirts of the city. The Hydro-Electric Power Commission, finding that the business was not profitable at present, is unwilling to carry out the agreement to furnish electrical service for these districts. The Council proposes to enter into an agreement with a private company, with a provision that the Hydro-Electric Commission may take over the system when the population is sufficient to make the business profitable.

OUTLOOK, SASK.—A by-law will be submitted to the ratepayers authorizing an expenditure of $10,500 for extensions and improvements to the electric-light plant.

Miscellaneous

KETCHIKAN, ALASKA.—The Citizens' Lt., Pwr. & Wtr. Co., of Ketchikan, is installing a 1000-hp McCormick (Francis type) turbine directly connected to a 600-kva, two-phase, 2300-volt Westinghouse generator (second unit). J. C. Barber is president.

PANAMA.—Bids will be received by Major F. C. Boggs, general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 22 for transformers, switchboards, motor-generator sets and miscellaneous electrical apparatus, as per circular No. 806. For further details see proposal columns.

PANAMA.—Bids will be received at the office of the general purchasing officer, Isthmian Canal Commission, Washington, D. C., until Nov. 14, for furnishing window frames and sashes for hydroelectric station and varnished-cambric, lead covered cables. Blanks and general information relating to this circular (No. 805) may be obtained from the above office or the offices of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

New Incorporations

DUNCOMBE, IA.—The Duncombe Lt. & Pwr. Co. has been incorporated with a capital stock of $10,000. The officers of the company are: W. J. Wagner, president; J. J. Claussen, vice-president; D. Maricle, secretary, and Elias Nelson, treasurer, all of Duncombe.

TOMPKINSVILLE, KY.—The Tompkinsville El. Lt. & Ice Co. has been incorporated with a capital stock of $2,000 by John Brown, B. Brown and O. Brown, all of Tompkinsville.

LUTCHER, LA.—The Lutcher Ice & Lt. Co. has been granted a charter with a capital stock of $25,000 to generate and distribute electricity for lamps and motors and to manufacture and sell ice. R. J. Younger is president and J. A. Daspit secretary.

BIRD ISLAND, MINN.—The Renville County El. Co. has been incorporated with a capital stock of $50,000 to furnish electricity for lamps, heat and motors; also to furnish steam for heating and power purposes. The incorporators are: H. B. Rutledge, B. F. Allen, of Glencoe; W. R. Rutledge, of Howard Lake; A. J. Richardson, of Bird Island, and A. M. Ericson, of Hector.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED OCT. 28, 1913.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York.]

1,076,672. VAPOR RECTIFIER FOR HIGH-POTENTIAL CIRCUITS; J. Le R. Hayden, Schenectady, N. Y. App. filed June 16, 1905. Avoids "striking back" or arcing by preventing excessive heat at the anode.

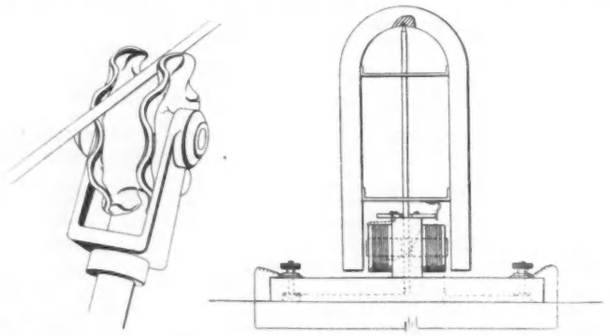
1,076,754. SAFETY APPLIANCE FOR ELECTRICAL INSTALLATIONS; W. F. Force, Flatbush, N. Y. App. filed Jan. 24, 1912. To prevent unauthorized substitution of fuse strips of different capacity from those intended to be used.

1,076,788. TROLLEY; J. J. Sabo, Pittsburgh, Pa. App. filed Aug. 19, 1912. Has pivoted upstanding finder fingers.

1,076,789. PRIMARY BATTERY; A. L. Saltzman, East Orange, N. J. App. filed Feb. 10, 1911. Battery elements supported from the cover by a single frame.

1,076,858. ELECTRIC HEATER; W. S. Andrews, Schenectady, N. Y. App. filed June 12, 1908. Metallic heating element wound on a quartz rod inclosed within a quartz tube.

1,076,870. CONDUIT FISH WIRE MACHINE; B. Dahl, Minneapolis, Minn. App. filed June 15, 1912. Wire is fed by a revoluble disk having a spiral groove in which the wire is laid.



1,077,147 and 1,077,179.—Trolley Wheel or Sheave, and Electromagnetic Motor

1,076,873. MANUFACTURE OF INCANDESCENT FILAMENTS; G. Dobkevitch, Paris, France. App. filed July 7, 1909. Heats metalliferous decarbonized filament to a white heat in an atmosphere of hydrogen and ammonia.

1,076,884. VAPOR RECTIFIER FOR HIGH POTENTIAL CIRCUITS; J. L. R. Hayden, Schenectady, N. Y. App. filed Oct. 25, 1905. Decreases arcing between the anodes by locally cooling the cathode.

1,076,887. ELECTRIC MELTING FURNACE; L. E. Howard, La Grange, Ill. App. filed Feb. 6, 1909. Secondary of the induction coil consists of a fused portion of the bath within the furnace basin and unfused conductor outside of and below the basin.

1,076,896. ELECTRIC SIGNALING SYSTEM; C. E. Lee, Chicago, Ill. App. filed Jan. 24, 1913. Calls parties wanted at telephone by a signal sounded simultaneously at a plurality of locations in the establishment.

1,076,907. LOCK ATTACHMENT FOR SNAP-SWITCHES; C. D. Platt, Bridgeport, Conn. App. filed Feb. 12, 1913. Key-operated switch; guard with points prevents unauthorized person from turning switch spindle.

1,076,908. ANTISEPTIC PROTECTOR FOR MOUTHPIECES; C. T. Porter and R. J. Osborne, San Francisco, Cal. App. filed June 18, 1913. Antiseptic pad supported on telephone mouthpiece.

1,076,927. BATTERY HOLDER; G. N. Waterbury, Jr., Washington, D. C. App. filed Dec. 7, 1911. Holder for dry cells, with spring connectors between cells.

1,076,944. TELEGRAPHIC PERFORATING RECEIVER; H. Bille, Copenhagen, Denmark. App. filed Nov. 3, 1911. Constantly rotating motor and signal-controlled devices act together to actuate a tape perforator.

1,076,949. VALVE TUBE; E. W. Caldwell, New York, N. Y. App. filed April 19, 1912. Self-regulating Villard type valve tube.

1,076,990. TELEPHONE SYSTEM; C. W. McGonigle, Algona, Wash. App. filed July 15, 1913. Provides for concurrent conversations over a single main line and insures remote instruments receiving as distinct communications as nearer instruments.

1,077,018. TROLLEY; S. G. Valles, Havana, Cuba. App. filed April 8, 1913. Brushes at sides of wheel have their ends clamped in a pyramidal recess in end of trolley pole.

1,077,024. AUTOMATIC ELECTRIC REGULATOR; P. Werner and E. Juillard, Geneva, Switzerland. App. filed Sept. 8, 1910. Utilizes liquid under pressure to actuate an electric regulator.

1,077,038. AUTOMATIC CONTROLLING DEVICE FOR ELECTRICALLY HEATED APPARATUS. E. W. Brawner, Augusta, Ga. App. filed June 30, 1911. For incubators and the like.

1,077,140. SUBMARINE CABLE; F. Jacob, Westcombe Park, England. App. filed April 30, 1912. Provided with artificial self-induction load and with insulation composed of balata closely surrounding each conductor.

1,077,147. TROLLEY WHEEL OR SHEAVE; A. E. Lineburg, Wilkes-Barre, Pa. App. filed Feb. 26, 1913. Flanges of wheel formed with inwardly extending projections.

1,077,163. MEANS FOR PROTECTING ELECTRIC CIRCUITS FROM EXCESSIVE RISES IN PRESSURE AND SIMILAR DISTURBANCES; R. Rüdenberg, Charlottenburg, Germany. App. filed March 14, 1913. Concentrated inductance and a resistance in parallel in one side of the line and a concentrated capacity connected between the two sides.

1,077,175. STORAGE-BATTERY POWER AND CHARGING EQUIPMENT; C. H. Thordarson, Chicago, Ill. App. filed June 27, 1910. Plurality of storage batteries alternately switches from and to the charging and load circuits.

1,077,179. ELECTROMAGNETIC MOTOR; A. I. V. Wilson, Atlanta, Ga. App. filed Aug. 18, 1910. Electromagnet for stator and permanent magnet for rotor.

1,077,185. PARTY-LINE SYSTEM FOR AUTOMATIC TELEPHONE EXCHANGES; F. Aldendorff, Antwerp, Belgium. App. filed Oct. 22, 1912. Selective ringing current applied to a party line by ringing current selectors independent of the connectors or final selectors which establish the connection with the wanted line.

1,077,219. THERMAL GENERATOR; W. W. Coblentz, Washington, D. C. App. filed Aug. 8, 1913. Thermal elements embedded in cementitious material and joined together on both sides of said material with heat-absorbing material surrounding one set of junctures. (Dedicated to the public.)

1,077,225. TELEPHONE-SYSTEM STATION INSTRUMENT; A. E. Keith, Hinsdale, Ill. App. filed Dec. 10, 1909. Transmitter, receiver and calling mechanism all embodied in one unitary portable structure.